Aerial view of Baltimore, looking southeast toward the Patapsco River (Furnished by Baltimore Association of Commerce.)

(*Frontispiece*)

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JOSEPH T. SINGEWALD, JR., *Director*

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GEOLOGY AND GROUND-WATER RESOURCES OF THE BALTIMORE AREA

By

Robert R. Bennett and Rex R. Meyer

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PREFACE

Except for the public water supply of Baltimore City, the Baltimore area is dependent largely upon ground water for its water supply. Even within the boundaries of the Baltimore public water supply, ground water better meets many industrial requirements than does the public supply of surface water.

The concentration of the major industries around the Patapsco River in and below the City of Baltimore had long ago led to overpumping in the more highly developed industrial districts, resulting in excessive lowering of the water levels and contamination of the ground waters. The augmented demands of the expanding industries during World War II threatened further depletion and contamination of the ground-water supplies.

A cooperative investigation of the ground-water resources of the Baltimore area was started in the winter of 1943 by the United States Geological Survey and the Maryland Department of Geology, Mines and Water Resources. Maryland funds under the cooperative agreement were provided by special appropriations from the Board of Public Works and the Bureau of Water Supply of the City of Baltimore to carry the work to the end of the fiscal year 1945. During that period the major part of the field work was completed. Since July 1, 1945, the Maryland share of the cost has been provided from the budget of the Department of Geology, Mines and Water Resources.

The assembling and interpretation of the field data has been a huge task. At the same time Messrs. Bennett and Meyer continued augmenting the field data and kept in touch with current ground-water developments. Much of their time also has been diverted to the investigations in Southern Maryland and other parts of the State that were initiated when regular budget appropriations for ground-water investigations became available beginning July 1, 1945. Rapidly increasing service calls for ground-water information and aid have also demanded much of their time since 1945. The exigencies of the overall ground-water program in Maryland consequently have retarded the completion of this report.

The report has been prepared with most commendable care and thoroughness. It presents an analysis of the ground-water resources of the Baltimore area and recommendations regarding their future use and development that are of great value to the existing industries and that will be of inestimable value in guiding further industrial development in the area.

The Department of Geology, Mines and Water Resources is indebted to the United States Geological Survey for its generous financial support and for the wholehearted cooperation of its personnel which have made possible this outstanding investigation of the ground-water resources of the Baltimore area, and for the privilege of publishing the results. The Department is indebted also to Mr. Robert R. Bennett and to Mr. Rex R. Meyer, geologists of the Water Resources Division of the United States Geological Survey, for the perseverence and thoroughness with which they conducted the investigation and prepared the report.

JOSEPH T. SINGEWALD, JR., *Director*.

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GEOLOGY AND GROUND-WATER RESOURCES OF THE BALTIMORE AREA

BY

ROBERT R. BENNETT and REX R. MEYER

ABSTRACT

The Baltimore area comprises the city of Baltimore, and most of the area from the Susquehanna River south to Laurel, essentially between the Piedmont Plateau and the Chesapeake Bay. Most of the large ground-water developments are in the industrial districts in and near Baltimore; consequently that part of the area was investigated in greater detail. With the exception of the northern part of Baltimore, which is in the Piedmont Plateau, the area is chiefly in the Coastal Plain.

The Piedmont Plateau is underlain by pre-Cambrian crystalline rocks consisting mostly of gabbro, schist, granite, and gneiss. Owing to their greater resistance to erosion the land surface of the plateau is higher and more rugged than the Coastal Plain, which is underlain by soft unconsolidated sediments of Lower and Upper Cretaceous and Pleistocene ages. The land surface of the Coastal Plain slopes gently southeastward toward Chesapeake Bay. In some places estuaries, which are tributaries of Chesapeake Bay, extend northwestward across the Coastal Plain to the Piedmont Plateau.

The Coastal Plain sediments were deposited on the southeastward-sloping surface of the crystalline rocks. They form a wedge-shaped mass that thickens progressively from west to east. The strike of the formations of Cretaceous age is approximately parallel to the boundary between the Piedmont Plateau and the Coastal Plain (Fall Line). As these formations dip gently to the southeast they crop out as bands of irregular width trending northeast. The Pleistocene deposits are essentially flat lying and were deposited on the eroded surface of the pre-Cambrian and Cretaceous rocks.

In most of the area the sediments of Lower and Upper Cretaceous age, which consist essentially of irregular and lenticular beds of sand, gravel, and clay of continental origin, may be divided into three formations: the Patuxent formation of Lower Cretaceous age, and the Arundel clay and Patapsco formation of Upper Cretaceous age. Their combined thickness ranges from about 475 to 750 feet. The Pleistocene deposits, which consist chiefly of irregular beds of sand, gravel, and clay of continental and estuarine origin, are divided, in this report, into an upland and lowland unit. The combined thickness of these units ranges from nearly nothing to 175 feet.

Owing to the great difference in water-bearing properties of the crystalline rocks in the Piedmont Plateau and the unconsolidated sediments in the Coastal Plain, ground water occurs under two widely different sets of conditions. In the crystalline rocks the water is contained chiefly in joints and other fractures which are not uniform in size and gradually disappear with depth, consequently the water-bearing zones are very irregular and inhomogeneous. The sand and gravel in the Coastal Plain sediments are considerably more porous and permeable and form relatively uniform and widespread aquifers. In general water-table conditions occur in the outcrop areas of the crystalline rocks and the Coastal Plain sediments, but down dip from the outcrops the ground water occurs under artesian conditions. Because of their low permeability, where they underlie a substantial thickness of unconsolidated sediments the crystalline rocks are not considered to be an aquifer in most of the Coastal Plain area.

The reported yields from 106 industrial wells ending in the crystalline rocks in Baltimore show an average yield of 50 gallons a minute, and a median yield of 35; the mode, or most typical value, is 10 gallons a minute. The reported yields range from 0 to 350 gallons a minute.

Industrial wells in the Patuxent formation in and near its outcrop have yields of about 200 to 300 gallons a minute, whereas wells in this formation down dip in the southeastern part of the area have yields of about 500 to 900 gallons a minute. Pumping tests and flow net analysis show that the coefficient of transmissibility of the Patuxent formation, the principal water-bearing formation in the area, averages about 20,000 gallons a day per foot in the industrial districts near the outcrop, and about 50,000 in the industrial districts in the southeastern part of the area. The coefficient of storage of the Patuxent formation, under artesian conditions, is about 0.00026; under water-table conditions in the outcrop area, it is estimated to be 0.15 to 0.20.

The Patapsco formation is an important water-bearing formation in the southeastern part of the industrial area where it is separated by clay into a lower and upper aquifer. The lower aquifer yields as much as 500 to 750 gallons a minute to industrial wells. Its coefficient of transmissibility averages about 25,000 gallons a day per foot. The upper aquifer, which yields as much as 500 to 800 gallons a minute to wells, has a greater thickness than the lower aquifer, so that its coefficient of transmissibility probably is more than 25,000.

The upland unit of the Pleistocene deposits is thin and caps the hills and ridges and is not an important aquifer. In some places, the lowland unit is sufficiently thick and permeable to yield large quantities of water to wells.

The large ground-water supplies in the industrial area have been developed since about 1900. The pumpage increased progressively to a peak of about 47,000,000 gallons a day early in 1942. Late in 1942 the pumpage was decreased by about 13,000,000 gallons a day and in 1945 was 34,000,000 gallons a day. From 1942 to 1945 the pumpage outside the industrial area increased

from about 3,000,000 to 5,000,000 gallons a day. The total pumpage in 1945 for the entire area was 39,000,000 gallons a day. The pumpage, in gallons a day, from each water-bearing formation, is approximately: pre-Cambrian crystalline rocks, 1,000,000; Patuxent formation, 30,000,000; Patapsco formation, 6,000,000; and Pleistocene deposits, 3,000,000.

Originally the artesian head in the aquifers generally was within a few feet of the land surface, but with the progressive increase in pumpage during 1940 to 1942 the artesian head in the Patuxent and Patapsco formations, in and near the centers of pumpage, declined respectively to as much as 160 and 190 feet below the land surface. The decrease in pumpage late in 1942 resulted in a rise in the artesian head; and at present, in most of the industrial area, the artesian head in the Patuxent and Patapsco formations ranges, respectively, from about 40 to 100 and 10 to 50 feet below the land surface. Detailed records of water-level fluctuations in observation wells show that during 1943-45 the general trend of water levels in most parts of the area was either slightly upward or essentially horizontal.

The ground water in the Baltimore area normally has a low mineral content, but the lowering of the water table or artesian head has caused salt water, chiefly from the Patapsco River estuary, to enter the aquifers and spread laterally throughout a large part of the industrial area.

Industrial wastes, chiefly sulfuric acid, also have contaminated the ground water in a small part of the industrial area.

The contamination of aquifers through leaking wells is a serious ground-water problem in the industrial area. As the artesian head in the Patuxent formation is lower than it is in the Patapsco formation or Pleistocene deposits, highly mineralized water may enter a well through a defective casing or move downward outside an improperly sealed casing and contaminate the water in the Patuxent formation. Although this problem is now serious, the repair of leaking active wells and effective plugging of abandoned wells would appreciably reduce this contamination in a relatively short time.

Practically all ground water pumped in the Baltimore area is derived from precipitation on the outcrops of the aquifers. The potential rate of recharge to the aquifers in the Coastal Plain exceeds the theoretical maximum quantity of water that can be transmitted through them. The rate of recharge, therefore, does not limit the quantity of water that can be pumped in the artesian part of the area.

The concentration of pumping has caused the water table or artesian head in the Patuxent formation to be so low in and near some of the centers of pumping that very little additional water can be developed from that formation in those parts of the industrial area. The water table or artesian head between the centers of pumping, however, is relatively high and if the wells were spaced at greater distances additional water could be pumped. The

heavy pumping from the Patuxent formation, chiefly in and near its outcrop adjacent to the Patapsco River estuary, has caused local encroachment of salt water. However as pumping in and near that part of the outcrop area prevents most of the salt water now in the formation from moving to major well fields in the other industrial districts, it would not be advisable to decrease or discontinue this pumping.

Heavy pumping over a period of many years throughout the industrial area has caused local encroachment of salt water in the Patapsco formation, so that most of the pumping from the formation has been discontinued. The present pumpage is chiefly from the aquifer in the lower part of the formation in the southeastern part of the area where a large part of the water is derived from areas in which the Patapsco formation contains fresh water. Although this pumping is still causing encroachment of salt water, it would not be desirable to discontinue the pumping at least until all leaking wells drilled to the Patuxent formation are repaired or plugged. Even if the pumping were discontinued, many decades would pass before the salt water in the formation would be flushed out. It would not be advisable, however, to develop additional supplies of ground water from this formation in the industrial districts up dip as they are near the main source of contamination.

The economic value of ground water in the industrial area is different for various types of uses and there is little uniformity in the chemical quality of water that can be used. The application of the term safe yield in the sense that it represents a single rate of pumping for the entire industrial area would be unrealistic. It is apparent that owing to the contamination of the water the safe yield has been exceeded for some industries.

INTRODUCTION

GEOGRAPHY

The Baltimore area, as the term is used in this report, comprises the city of Baltimore and parts of Harford, Baltimore, Anne Arundel, and Howard Counties (fig. 1). The area is bounded on the north by the Susquehanna River and extends south to the vicinity of Laurel, which is about midway between Baltimore and Washington. Chesapeake Bay and the Piedmont Plateau form, respectively, the approximate eastern and western boundaries. As most of the large ground-water developments are in the industrial districts in and near Baltimore (fig. 2), that part of the area was investigated in more detail.

According to the census of 1940 Baltimore had a population of 859,100, and was the seventh largest city in the country (Pl. 18, frontispiece). During World War II, thousands of people moved to Baltimore to work in war industries and much of the resulting increase in population has been retained. The postwar metropolitan population is more than 1,000,000 and Baltimore is the sixth largest city in the country.

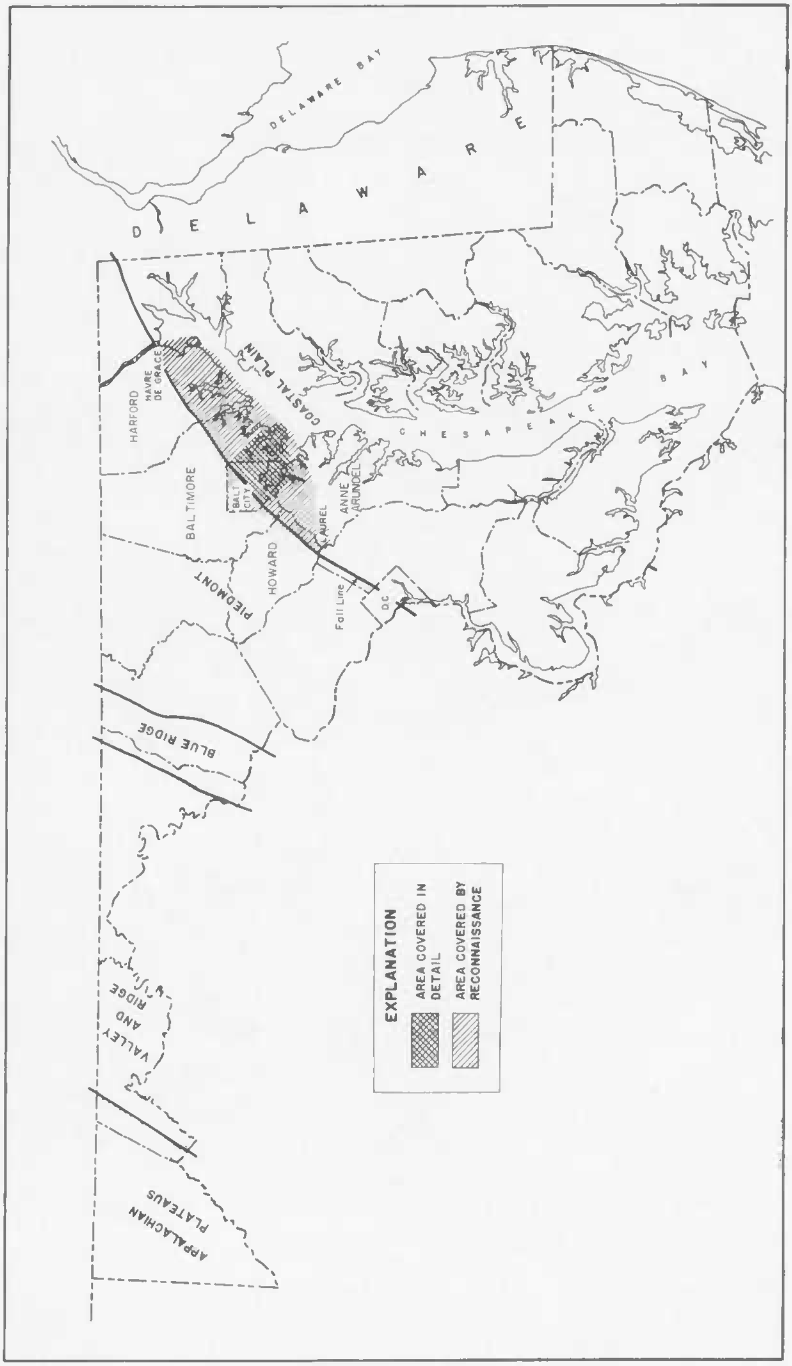

FIGURE 1. Map of Maryland showing physiographic provinces and area covered by this report

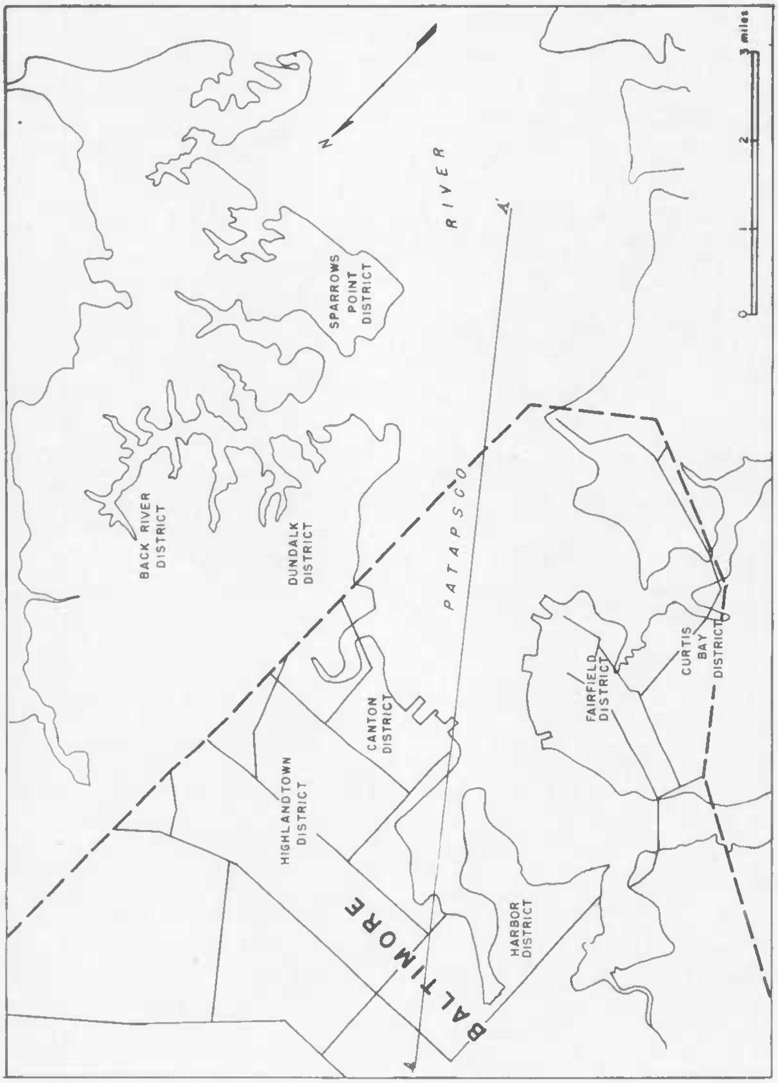

FIGURE 2. Map showing location of districts in the Baltimore industrial area

The area outside Baltimore and its environs is less densely populated and in general has a rural appearance. In 1940, Havre de Grace and Aberdeen, the largest towns within the area northeast of Baltimore, had populations of 4,967 and 1,525, respectively. Their population rose during the recent war owing to the expansion of the military establishments in their vicinity. Laurel, the largest incorporated town in the southern part of the area, in 1940 had a population of 2,823; and Glen Burnie, which is unincorporated, had an estimated population of 625. Those towns also expanded considerably during World War II owing to their proximity to military establishments or war industries.

Baltimore is one of the world's largest seaports as well as a large manufacturing center. Many of the factories are near the Patapsco River estuary where they are served by ocean-going vessels that bring in raw materials. During 1939 Baltimore was third among the seaports in the United States in the tonnage of waterborne commerce, and second in the volume of foreign trade.

Products too numerous to list are manufactured in the Baltimore industrial area. Some of the large industries are: the world's largest tidewater steel plant, one of the largest airplane plants, shipbuilding and ship-repair plants, radio and telephone equipment industries, the largest spice factory in the world, the largest bottle-cap factory, the largest producer of portable electrical tools, the largest copper refinery, and one of the largest whiskey industries.

Most of the area outside of the Baltimore industrial area is farmed, but military establishments occupy a substantial part. Among the largest of these establishments are the Aberdeen Proving Ground near Aberdeen, the U. S. Army Chemical Center near Edgewood, and Fort George G. Meade near Odenton.

Sand and gravel are mined at several localities for use in construction of roads and for building purposes; clay, used principally in the manufacture of bricks, is mined at a few localities.

PURPOSE AND SCOPE OF INVESTIGATION

Ground water, which is used in the Baltimore area for industrial, public, and domestic purposes, has been developed chiefly for the following reasons: (1) the relatively low cost of producing water from wells; (2) the uniform temperature of the water, which is lower in the summer than that of surface water, an important factor in cooling operations in industries; and (3) the low mineral content of the water, a requirement for the use of water in boilers and for processing in some industries. In the past, many ground-water supplies were developed without benefit of a knowledge of the geology or hydrology of the area; as a result, in some parts of the area, the water-bearing formations became contaminated with highly mineralized waters and the static water levels in wells lowered markedly. In recent years these serious conditions caused concern over the possibility that the valuable ground-water supplies might be ruined by widespread contamination or be depleted seriously by overpumping or improper development.

It is difficult to determine accurately the value of the ground-water supplies in the Baltimore area, as the water is used for many different purposes. Geyer (1945, pp. 12-13) computed that the loss of the water obtained from 150 large wells in the industrial area in and near Baltimore, would represent a loss of $1,000,000 annually; however, this amount is a minimum as it does not include the additional monetary value of the uniform low temperature and the normally low mineral content of the water.

The recognition of the serious contamination and apparent overdevelopment of the ground-water supplies led to the arrangements for the investigation described in this report. The investigation was planned to determine, so far as practicable, the "safe yield" of the water-bearing formations, the cause and extent of the contamination of the aquifers by highly mineralized waters, remedial measures that would restore some of the contaminated well fields for continued use, and general information that would lead to a more prudent development of additional ground-water supplies.

The geology of the area was studied chiefly as it applied to the occurrence of ground water; however, as the classification of the rock strata proved to be difficult, it was necessary to spend considerable time on geologic studies. The geologic studies included examination of the outcrops; plotting of practically all the well logs; construction of a peg model, a three-dimensional representation of most of the deep wells drilled in and near Baltimore; and the collection and microscopic study of drill cuttings from wells. It was not until the latter part of the investigation that sufficient information became available to correlate the geologic units with any degree of accuracy.

It became apparent during the early part of the investigation that some water-bearing formations were being contaminated through leaking wells that had been abandoned for many years; hence it was considered advisable, so far as was practicable, to obtain the records and determine accurate locations of all wells drilled in the contaminated areas; consequently a major part of the investigation consisted of making an inventory of the wells in the industrial area. Well data were collected by studying the available files of industrial concerns, previous reports, and by interviewing well drillers, well owners, and other persons. The well data that were considered the most valuable included depths, static and pumping water levels, casing and screen records, and, if the well was in use, the amount of water pumped.

To provide a sufficiently large scale to show wells separately for purposes of study, the recorded wells within the city limits of Baltimore were plotted on 1-mile-square maps having a scale of 1 inch = 50 feet. The reproduction of these large maps in this report was impractical, and for publication the wells were plotted on a map having a scale of 1 inch = 1,500 feet (Pl. 1). Owing to the large number of wells in some parts of Baltimore an index-numbering-system was used to facilitate locating the wells on Plate 1. All wells are referred to mile squares which are in turn referred to the Washington Monument, in the center of the city. Thus well 2S3E-9 is in the square mile 2 miles south and 3 miles east of the center of the city; the figure 9 is the number of the well and indicates it is the ninth well inventoried in that square mile.

Wells outside of Baltimore are numbered by a county system. Each county is divided into 5-minute quadrangles formed by the intersection of longitude and latitude lines. The 5-minute intervals of latitude are classified alphabetically by upper case letters along the left and right sides of the county map. The 5-minute intervals of longitude are classified alphabetically by lower case letters along the top and bottom of the map. Thus well Bal-Gf 9 indicates that the well is in Baltimore County in the latitude interval opposite "G", the seventh 5-minute interval from the top of the map, and in the longitude interval "f", the sixth 5-minute interval from the left side of the map. The figure 9 is the number of the well and indicates it is the ninth well inventoried within that quadrangle. In this report, however, only parts of the county well maps (Pls. 3 and 4) are included and the identifying coordinate letters are placed in each 5-minute quadrangle rather than along the sides of the map.

The water levels in selected observation wells were measured periodically, usually at weekly or monthly intervals; several wells were equipped with automatic water-stage recorders that gave a continuous record.

Detailed chemical analyses were made of water samples collected from many wells, and a large number of chloride and pH determinations were made in the field. The contamination of wells by highly mineralized water was studied chiefly by means of chemical analyses of a series of water samples collected at intervals from wells that were pumped after being shut down for a certain time. The contamination of wells also was studied by means of geophysical well-exploration equipment.

The capacity of the water-bearing materials to store and transmit water—the coefficients of storage and transmissibility—was determined by pumping tests and flow-net analysis; and the permeability of samples of drill cuttings from some water-bearing beds was determined with a U. S. Geological Survey field permeameter.

Well-exploration equipment was designed and constructed for use principally in exploratory test holes. This equipment measured some of the electrical properties of the rocks and their fluid content, information of value in correlating the geologic units and in determining the approximate salinity of the water in the aquifers.

HISTORY OF GROUND-WATER DEVELOPMENT

The first ground-water supplies in the Baltimore area probably were developed in the 17th century. Most of the water was then derived from springs or shallow dug wells. The springs in and near Baltimore furnished the major part of the water supply during most of the 18th century. As the population increased and buildings were erected many of these springs became contaminated or ceased to flow (Baltimore Bureau of Water Supply, 1934, p. 3). In 1797 efforts were made to obtain a public water supply, however, it was not until 1806 that a water company was able to furnish water to the city. This company diverted water from Jones Falls for most of its supply.

That some of the springs were still being used in 1809, after the public supply was constructed, is shown by the following quotation:

> "The natural springs of water with which the soil originally abounded, being threatened with destruction by other improvements, Jesse Hollingsworth and Peter Hoffman solicited and obtained power to purchase the ground and spring on North Calvert Street for the corporation; and with Mr. John Davis, were appointed to erect a public fountain there. Eight years after, money was appropriated by the city government for the purchase and improvement of the springs in the southern and eastern parts of the city, known by the names of Clappe's and Sterret's springs, and soon after a fountain of running water, supplied by the water company, was fixed at the Centre Market at the expense of the City." (Scharf, 1874, p. 303.)

A map of the Baltimore Water Co. distribution system made in 1831 shows that a spring near Center and St. Paul Streets was then used as a small part of the supply.

The city purchased the Baltimore Water Co. in 1854. The system was not equipped to furnish water above an altitude of 136 feet; all inhabitants living at sites above that altitude had to rely on springs and wells for water. As many parts of the city were in need of additional water, it was decided to drill several artesian wells in localities where water was most needed. The first of these wells was drilled in April 1855 on Block Street (Baltimore Bureau of Water Supply, 1934, p. 7), in the Harbor district about half a mile east of Federal Hill. No data on this well or on other wells that may have been drilled for the Baltimore public supply were found during the present investigation. Apparently the city's surface-water supply was soon expanded so that after about 1855 ground water was used very little, if at all, for the main public supply. The Baltimore public water supply is now obtained from Gunpowder Falls, north of the city, and from the North Branch of the Patapsco River.

Widespread drilling of artesian wells did not start until about 1853, but the demand for ground water must have grown rapidly for by 1860 about 100 artesian wells had been drilled in Maryland, nearly all in or near Baltimore (Tyson, 1860). Of these 100 wells, 90 were considered to have been successful. Up to that time most of the wells that had been drilled for industrial purposes in and near Baltimore were in the Harbor district and probably all these wells initially furnished ample supplies of good water.

In the latter part of the 19th century wells were drilled in the Harbor, Canton, Dundalk, Sparrows Point, and Curtis Bay districts. During that period large supplies of ground water were developed for industrial use, and as a consequence the ground-water supplies in the Harbor district were overdeveloped, causing salt-water contamination and decrease in yield of some wells.

During that period apparently few wells were drilled outside of the Baltimore industrial area as Darton's report of 1896 shows that there were relatively few other artesian wells in the Coastal Plain of Maryland. Darton's report (pp. 137-141) gives records of 201 artesian wells in the Baltimore industrial area, which indicate that even about 50 years ago, some wells in the Harbor district were contaminated with salt water or had decreased in yield.

Records of ground-water supplies for the early part of the 20th century, before the first World War, are not sufficiently complete to give an adequate history of the development during that period. A report (Wehr and Walden) prepared in 1913 included several chemical analyses of water from wells in the Baltimore industrial area, and those analyses indicate that the water was generally of good chemical quality. It is likely that the development of ground-water supplies increased considerably during and shortly after the first World War, the centers of pumping shifting from the Harbor district to the outlying districts adjacent to the Patapsco River. During the first World War ground-water supplies were developed for military establishments at the Aberdeen Proving Ground in Harford County and at the U. S. Army Ordnance Depot in Anne Arundel County near Baltimore.

The rate of pumping after the first World War increased gradually in the Baltimore area until about 1935, after which it increased rapidly and reached a peak early in 1942 of about 50,000,000 gallons a day. Salt-water contamination of aquifers and wells became more widespread during this period, so that most of the wells in the Harbor and Canton districts, and many wells in the other industrial districts, were abandoned. Late in 1942 one large industrial plant in the Sparrows Point district decreased its pumpage by about 10,000,000 gallons a day because of the low pumping levels and salt-water contamination of some parts of the aquifers; and the pumpage in the Curtis Bay district was decreased by about 3,000,000 gallons a day. Since then the pumpage in the industrial area has not changed; however outside the industrial area the pumpage has increased from about 3,000,000 gallons a day in 1942 to about 5,000,000 gallons a day in 1945. Hence the total pumpage in the entire area in 1945 was 39,000,000.

PREVIOUS INVESTIGATIONS

The growth of knowledge of the geology of the Baltimore area has been described in detail by Berry (1929, pp. 34-57) and in a publication by Clark, Bibbins, and Berry (1911, pp. 34-56); hence, only the more comprehensive geologic publications or those that include comments on or discussions of the ground-water resources are listed in this report.

One of the first to observe and report on the ground-water supplies in the Baltimore area was Levi Disbrow (Silliman, 1827, pp. 136-143). Disbrow, some time before 1823, studied the drilling technique used in the drilling of salt wells west of the Allegheny Mountains (Carlston, 1943, p. 123), and soon thereafter used those methods to obtain fresh-water supplies for domestic and industrial use in the east. Disbrow (Silliman, 1827, p. 140) reported the log and static water level of a well drilled near Baltimore, in addition to the records of other wells in nearby states north of Maryland.

In these early days, nearly 120 years ago, Benjamin Silliman, editor of the American Journal of Science, was apparently impressed by the need for study of ground-water conditions and the methods for obtaining water from wells, for in commenting on the notices by Disbrow concerning the successful development of artesian water supplies, he stated:

> "There can be no doubt that the research ought to be prosecuted with vigor and perseverence * * * if for instance as in some cases cited in this notice, good water in abundance can be brought near the surface * * * it is the right of a corporation and the citizens, if necessary, to deny themselves their luxuries, and even a part of their daily bread, to procure what is next in importance to bread itself." (1827, p. 142.)

The first study of ground-water resources in the Baltimore area was made by Philip T. Tyson (1860; 1862), who was State Agricultural Chemist. Tyson made many observations of the water-bearing formations of the State and wrote two articles dealing with well-water supplies. The reports of Tyson, though brief, provide some excellent records of wells drilled in and near Baltimore, and his descriptions of ground-water conditions found in drilling show that he was a keen observer, deeply interested in the subject.

In 1885-86 McGee (1888) made an investigation, under the joint auspices of the United States Geological Survey and the United States Fish Commission, to determine the probable success of an artesian well at Fishing Battery Station near Spesutie Island, 5 miles south of Havre de Grace near the head of Chesapeake Bay. His report describes the record of a well drilled at Fishing Battery Station (p. 580), but the report is devoted chiefly to geologic observations. McGee concluded from his studies that the rock strata were displaced by a fault or flexure across the Fall Line, the boundary between the Coastal Plain and the Piedmont Plateau, and that this displacement, if large, might have some effect on the occurrence of artesian water in the Coastal Plain area.

Information on the ground-water conditions in the Coastal Plain of Maryland is included in Darton's reports (1894; 1896) on the Atlantic Coastal Plain. Darton's reports consist chiefly of well records, logs, and general information on the water-bearing formations; he classified the water-bearing formations in the Baltimore industrial area into several water-bearing zones. Clark and Mathews (1906) described the geology and mineral resources of Maryland and their report includes a brief section on the occurrence and value of mineral springs; however, all the springs listed are outside the Baltimore area.

In 1906 a comprehensive report (Shattuck, 1906) on the Pliocene and Pleistocene deposits of Maryland was published.

Shattuck, Miller, and Bibbins (1907) made a detailed geologic map of the Patuxent quadrangle. Their discussion of the geology includes a brief section on the water resources.

A comprehensive report (Clark, Bibbins, and Berry, 1911) on the Lower Cretaceous deposits of Maryland was published in 1911. This report includes many measured geologic sections and fossil descriptions, a history of the sedimentation, and correlations of the Lower Cretaceous sediments with deposits in other areas throughout the world. It is the most complete report ever prepared on the Lower Cretaceous deposits in the Baltimore area; for the most part, however, the report deals with the exposed sediments, as few subsurface data were available at that time.

Wehr and Walden (1913), consulting engineers, investigated the groundwater conditions in the Baltimore industrial area in 1913. Their published report is based largely on the data given in Darton's report (1896) and on records of wells obtained from the Maryland Geological Survey. Their report, however, includes a table of chemical and bacteriological analyses, made specifically for their study, of samples of water from 20 wells in the Baltimore industrial area.

A comprehensive report, by Clark, on the Upper Cretaceous sediments was published in 1916.

A report (Little, 1917) on Anne Arundel County, a part of which is within the southern part of the Baltimore area, is devoted principally to a discussion of the geology as determined by examination of the outcrops. The report includes a brief section (pp. 128-132) on the ground-water resources of the county.

The Tolchester folio (Miller, Mathews, Bibbins, and Little), published in 1917, includes a short section on the ground-water resources, but the report is concerned particularly with a description of the geologic formations. The Tolchester quadrangle includes only a small part of the Baltimore area.

The Maryland Geological Survey was the first organization to undertake a study of the ground-water conditions in the entire State. During the early part of the 20th century this department collected numerous well records and observed the general features of the water-bearing formations in Maryland, as well as in Delaware and the District of Columbia. A report (Clark, Mathews, and Berry) of the findings was published in 1918; it is still the only publication that deals with the water resources of the entire State. The report includes general information on the water-bearing formations and records of wells in the Baltimore area.

The first investigation of the salt-water contamination of the aquifers within the Baltimore industrial area was made by Singewald (1920), who studied the ground-water conditions in the Curtis Bay district. His unpublished report contains many determinations of chloride in water samples from wells, and a discussion of the geologic formations and their relation to the occurrence of ground water.

In 1929 the Maryland Geological Survey published a report (Berry, Knopf, Jonas, Mathews, and Watson) that includes a detailed discussion of the geology, physiography, and mineral resources of Baltimore County. The section on the ground-water resources contains essentially the same data as the report by Clark, Mathews, and Berry published in 1918.

The first study of the ground-water resources within the Baltimore industrial area that included a quantitative treatment of the ground-water problems was made by Wolman in 1941. This unpublished report concerns both surface and ground-water supplies that would be available for industrial use in the Sparrows Point district. The report is of singular importance, as it is the first in the Baltimore area to utilize the modern concepts of ground-water hydrology in water-supply investigations.

Later in 1941 the Ranney Water Collector Corporation prepared a report on the shallow ground-water resources, chiefly in the Sparrows Point and Dundalk districts. Several shallow test holes were drilled in connection with that study and pumping tests were run to determine the permeability of the water-bearing material.

In 1941 and 1942 Barksdale made three brief investigations in the Sparrows Point and Curtis Bay districts at the request of the War Production Board. The investigations included an inventory of some of the larger industrial wells and pumping tests to determine the cause of salt-water contamination in some of the wells. The results of the investigations are given in unpublished memorandums.

The first detailed report on the ground-water conditions in the entire Baltimore industrial area was made by Geyer, whose report was published in 1945. This report contains a wealth of data; through the kindness of Dr. Geyer and Dr. Wolman, who directed the study, all these data, though unpublished at the time, were made available to the writers for use in the present investigation.

During the present investigation the senior author (1945A, 1946) prepared two brief reports that describe the general features of the ground-water conditions of the Baltimore area. A detailed report (1945B) on the results of exploratory test-well drilling in the Sparrows Point district was prepared in 1945.

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The writers are greatly indebted to the industries and other well owners in the area for their cooperative spirit in supplying information on their ground-water developments. Dr. Abel Wolman, professor of sanitary engineering, The Johns Hopkins University, assisted the writers in arranging for well-exploration tests and provided information on the water supplies in the area. Dr. John C. Geyer, professor of sanitary engineering, The Johns Hopkins University, freely provided the writers all ground-water data he had collected during his study of the area. Dr. Geyer also gave valuable advice and assistance in preparing the flow-net diagram (Pl. 7).

Mr. George L. Hall, Chief Engineer of the Maryland State Board of Health, gave many records of wells and results of chemical analyses of water from wells. Dr. C. F. Miller, Electrical Engineering Department, The Johns Hopkins University, assisted the writers in the construction of electrical equipment for use in exploration of wells. Dr. J. L. Anderson, Department of Geology, The Johns Hopkins University, made the heavy-mineral determinations given in Tables 5 and 11.

The Shannahan Artesian Well Co. of St. Michaels, Maryland, one of the principal well-drilling companies in the industrial area, provided many logs and much other information on wells.

CLIMATE

The average annual precipitation at Baltimore for 74 years prior to 1946 was 42.52 inches. Although the annual precipitation ranged from a minimum of 21.55 inches to a maximum of 62.35 inches, in general the precipitation is uniform and well distributed through the year (Weeks, 1939, p. 4). The highest average monthly precipitation was 4.51 inches for August; the lowest average monthly precipitation was 2.76 inches for November.

TABLE 1

Monthly, Annual, and Mean Precipitation, in Inches, at Baltimore

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ann'l
1871	1.55	1.38	3.03	1.90	2.03	2.82	6.15	3.41	2.22	3.11	3.24	1.90	32.74
1872	0.88	1.46	3.06	3.06	1.44	4.16	1.58	4.59	5.06	4.08	3.17	2.22	34.76
1873	4.27	4.74	3.02	2.77	6.31	0.94	2.90	9.49	3.70	6.21	4.05	0.97	49.37
1874	2.22	3.18	1.41	6.65	1.92	1.11	4.30	3.47	4.83	0.16	2.48	1.90	33.63
1875	2.51	2.91	4.72	4.27	1.49	2.85	4.78	8.67	3.62	1.44	4.86	3.14	45.26
1876	1.67	2.96	6.37	1.90	4.94	4.09	5.64	1.76	10.52	2.79	2.74	1.32	46.70
1877	3.80	1.87	3.60	3.30	2.23	3.53	4.60	0.64	5.27	5.22	6.85	2.23	43.14
1878	4.51	3.31	4.74	4.19	5.38	4.09	4.66	4.82	0.82	4.41	3.55	5.61	50.09
1879	2.59	1.55	1.65	3.69	2.74	3.92	3.16	6.71	2.72	0.75	1.30	5.23	36.01
1880	2.26	1.96	4.82	3.07	1.23	5.48	6.47	4.44	1.78	2.64	2.86	4.89	41.90
1881	4.84	5.68	7.59	2.00	2.30	7.81	1.40	2.15	2.98	4.06	2.41	5.90	49.12
1882	5.38	3.73	3.43	2.14	3.42	2.30	4.02	5.10	9.38	0.86	0.65	1.70	42.11
1883	3.16	4.69	3.68	3.20	1.22	8.08	3.10	2.72	3.49	2.83	1.37	2.98	40.52
1884	4.81	6.69	6.37	2.65	3.17	2.51	9.43	1.74	0.09	1.42	3.09	3.91	45.88
1885	3.07	4.40	1.60	1.37	4.50	6.31	2.67	7.78	1.30	6.51	4.04	2.49	46.04
1886	4.48	5.49	4.85	2.06	7.07	5.64	8.08	3.94	1.90	1.39	4.09	3.12	52.11
1887	2.57	4.69	3.49	2.44	2.57	4.44	8.32	4.15	2.80	1.06	2.02	5.04	43.59
1888	3.35	2.83	4.62	2.11	4.22	3.22	2.82	6.17	4.90	2.99	3.04	3.26	43.53
1889	4.22	2.53	5.71	8.70	6.82	6.17	11.03	1.40	4.59	4.12	6.45	0.61	62.35
1890	1.80	4.80	4.07	3.94	5.98	2.42	3.61	6.44	4.76	5.73	0.74	2.67	46.96
1891	4.89	5.52	7.94	2.48	3.11	5.45	7.79	4.24	5.46	2.76	1.33	3.24	54.21
1892	6.42	2.41	7.20	3.15	6.35	4.87	4.07	1.83	2.36	0.26	3.85	2.28	45.05
1893	1.78	4.43	1.38	3.52	3.78	2.26	1.88	1.81	1.80	3.44	3.78	2.29	32.15
1894	1.46	3.53	1.19	3.80	7.26	3.29	1.73	1.41	4.75	3.80	1.98	4.12	38.32
1895	4.67	0.83	2.94	7.42	3.04	2.83	3.40	2.43	6.01	2.20	1.86	2.84	40.47
1896	2.62	7.07	4.70	1.44	1.61	3.94	6.32	1.93	4.14	1.11	3.34	0.37	38.59
1897	2.05	5.13	2.40	3.19	6.88	2.57	6.93	4.71	2.17	3.67	4.39	3.40	47.49
1898	2.99	1.32	2.58	1.84	3.86	1.06	3.51	6.09	1.56	3.97	4.34	3.34	36.46
1899	3.50	5.47	4.93	1.89	3.29	2.16	1.64	4.86	7.09	2.09	2.27	1.40	40.59
1900	2.11	4.65	3.17	2.06	1.00	4.34	1.51	2.91	4.26	1.68	1.81	2.07	31.57
1901	2.45	0.65	3.58	5.53	3.67	0.90	6.18	6.73	2.50	1.52	2.26	7.07	43.04
1902	3.05	4.68	3.41	2.90	1.62	4.30	2.45	4.31	7.19	6.85	3.71	5.66	50.13
1903	3.81	5.43	4.40	3.29	3.33	5.01	7.65	5.88	1.00	3.54	0.73	2.19	46.26
1904	2.86	1.50	2.88	2.37	1.84	3.27	4.58	1.95	5.90	3.73	1.87	3.34	36.09
1905	4.69	2.40	3.23	3.07	1.82	4.05	10.65	6.85	2.14	2.04	1.35	4.32	46.61
1906	3.22	2.21	4.63	3.31	2.73	5.10	7.96	5.80	0.32	5.74	1.74	4.06	46.82
1907	3.14	1.93	2.94	3.13	2.92	5.22	5.76	4.60	8.52	1.61	5.02	4.30	49.09
1908	3.49	4.71	2.50	1.09	4.04	1.08	4.34	5.17	2.59	2.59	0.77	3.04	35.41
1909	2.78	3.25	4.58	2.18	4.59	4.38	1.31	0.86	3.97	1.03	1.15	4.62	34.70
1910	4.68	2.28	0.46	7.76	2.95	5.30	0.95	1.37	2.13	2.71	1.93	2.45	34.97

TABLE 1—*Continued*

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ann'l
1911	3.48	2.31	2.45	2.69	3.45	5.52	3.53	12.28	1.60	3.31	4.28	3.68	48.58
1912	2.63	2.75	6.64	1.94	3.30	3.09	5.96	3.25	8.75	0.72	1.93	4.17	45.13
1913	2.45	1.61	3.89	5.15	3.12	1.47	2.63	6.38	1.51	3.50	1.82	2.58	36.11
1914	5.66	2.89	1.80	4.55	1.17	1.64	2.55	6.74	1.64	1.24	2.18	4.34	36.40
1915	6.81	4.75	1.06	1.37	3.19	6.23	2.22	9.93	2.30	3.86	1.59	3.08	46.39
1916	1.51	3.21	3.61	3.68	3.49	5.33	5.04	0.83	1.82	1.61	1.97	3.94	36.04
1917	3.04	1.75	3.80	2.21	3.24	4.05	7.09	2.39	2.86	5.01	0.52	1.96	37.92
1918	5.00	1.04	4.17	6.79	3.17	1.75	2.28	3.35	3.01	0.76	1.50	4.72	37.54
1919	3.51	2.62	4.22	4.05	5.46	2.69	7.21	6.45	2.31	2.50	3.10	3.11	47.23
1920	1.87	3.41	2.56	4.84	2.30	8.25	4.94	9.47	3.08	0.17	3.96	3.58	48.43
1921	2.05	2.85	2.60	2.59	5.99	1.97	4.93	3.49	3.19	1.61	4.37	2.08	37.72
1922	4.88	2.94	4.83	0.88	4.00	4.45	7.28	1.11	2.69	5.58	0.44	3.43	42.51
1923	4.14	2.51	4.12	3.68	2.59	1.84	2.04	3.14	3.85	2.83	2.04	3.88	36.66
1924	4.33	4.14	6.66	5.89	5.80	5.54	1.99	5.22	5.75	0.05	1.37	2.30	49.04
1925	5.35	0.98	2.00	2.66	1.86	1.01	5.57	2.41	0.75	5.43	3.16	1.54	32.72
1926	3.10	4.27	2.19	1.46	2.60	2.46	5.74	5.58	4.19	4.24	6.46	2.89	45.18
1927	1.38	3.78	1.47	5.48	2.03	2.96	1.41	3.04	1.95	6.90	2.22	3.61	36.23
1928	2.76	2.89	3.12	6.26	3.09	4.43	3.54	9.70	4.35	0.26	1.78	1.22	43.40
1929	2.90	3.45	3.16	6.73	1.78	4.82	1.13	4.04	2.79	6.77	2.44	2.46	42.47
1930	2.66	2.38	2.27	3.12	2.91	2.97	0.64	0.78	0.37	0.37	1.13	1.95	21.55
1931	1.89	1.41	4.62	2.77	5.80	1.89	6.04	7.98	2.05	1.79	1.13	2.20	39.57
1932	5.85	2.08	6.48	2.15	5.51	2.91	2.42	3.92	1.47	7.17	6.17	3.45	49.58
1933	3.37	2.95	4.60	7.58	5.17	3.09	3.90	13.83	3.28	1.76	0.96	2.47	52.96
1934	2.53	3.29	4.47	2.32	4.04	5.39	2.24	6.63	12.41	0.95	3.51	3.10	50.88
1935	4.79	2.74	2.82	5.12	4.51	5.01	4.55	3.97	7.59	2.63	5.63	2.16	51.52
1936	5.94	3.75	6.42	2.56	3.18	1.48	4.89	4.60	2.16	1.73	0.79	7.10	44.60
1937	6.74	3.52	1.93	7.92	3.27	3.53	3.81	5.06	1.10	7.75	5.21	0.95	50.79
1938	2.23	3.10	2.44	1.40	4.86	1.49	4.87	2.43	5.05	2.15	2.11	2.66	34.79
1939	3.77	6.52	3.75	5.92	1.47	3.86	2.41	3.52	3.08	4.01	0.76	1.87	40.94
1940	1.81	3.97	3.97	6.99	4.41	2.37	2.85	5.60	1.32	2.37	5.99	2.68	44.33
1941	3.29	1.07	2.20	3.29	3.61	7.77	5.61	1.60	0.50	0.99	1.32	3.48	34.73
1942	2.04	2.79	6.50	0.88	4.19	2.26	4.46	7.01	1.82	7.75	2.36	3.96	46.02
1943	3.53	2.08	4.38	2.56	4.76	1.29	4.95	0.86	1.84	6.29	2.77	1.44	36.75
1944	5.04	2.20	6.04	3.80	1.72	2.55	2.81	4.22	5.39	4.01	3.93	3.83	45.54
1945	3.75	3.44	1.41	3.55	3.50	2.65	9.68	2.48	5.06	1.18	3.92	5.99	46.61
Mean	3.42	3.22	3.75	3.54	3.54	3.64	4.43	4.51	3.54	3.03	2.76	3.14	42.52

TABLE 2

Monthly and Annual Mean Temperatures at Baltimore

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ann'l
1871	35.1	39.7	47.6	58.8	65.4	74.0	75.8	77.2	63.4	58.2	44.7	33.5	56.1
1872	34.2	35.9	36.9	55.2	67.2	75.3	81.5	79.4	69.0	57.0	43.4	31.8	55.6
1873	33.2	34.9	39.0	51.8	62.2	73.5	79.4	74.6	67.2	55.0	41.0	40.6	54.4
1874	39.1	37.1	43.4	46.4	62.2	75.2	77.3	72.3	70.0	56.5	45.0	38.8	55.3
1875	29.6	28.4	38.8	48.6	63.6	73.4	77.6	73.3	65.5	55.2	42.1	37.2	52.8
1876	40.6	37.0	39.0	51.0	64.0	75.8	80.0	75.4	65.2	51.5	46.0	27.4	54.4
1877	30.0	39.4	39.4	52.8	62.4	74.4	78.4	77.2	68.3	59.6	48.2	43.3	56.1
1878	35.0	40.4	49.0	58.2	63.0	69.8	80.8	75.8	69.2	58.9	46.8	34.9	56.8
1879	31.5	32.2	43.4	51.6	65.2	73.2	78.1	74.8	64.6	62.8	45.6	41.2	55.4
1880	42.4	40.6	42.6	55.0	70.9	75.6	78.1	75.5	68.8	56.0	41.8	31.0	56.5
1881	29.6	34.1	41.6	51.3	67.8	71.0	79.2	77.2	77.4	63.6	48.8	43.6	57.1
1882	34.2	40.8	45.2	52.3	59.0	74.2	77.4	74.1	69.3	61.6	44.2	36.2	55.7
1883	31.6	39.2	39.0	51.8	63.6	74.6	77.0	72.8	65.1	57.6	48.3	38.8	55.0
1884	32.0	41.6	43.8	52.5	64.8	73.1	75.5	75.7	72.4	60.8	47.0	37.9	56.4
1885	34.4	28.8	35.5	54.6	63.5	73.3	80.3	75.2	67.4	56.5	46.4	38.4	54.5
1886	29.4	33.0	42.2	55.6	62.5	70.4	75.0	74.3	70.1	59.4	47.0	31.6	54.2
1887	32.7	39.4	38.3	51.5	67.8	72.2	81.0	74.1	65.2	56.6	45.6	37.0	55.1
1888	29.2	35.7	37.2	52.6	62.8	73.2	74.6	76.2	65.3	52.7	47.9	37.6	53.8
1889	38.9	30.8	43.4	54.6	65.8	71.5	76.6	73.8	66.5	53.8	47.7	46.0	55.8
1890	44.0	43.4	41.6	54.0	64.0	75.0	75.4	74.1	68.4	57.0	48.2	34.6	56.6
1891	37.6	41.4	38.6	56.0	62.2	71.5	71.6	74.3	70.6	54.8	44.2	43.7	55.5
1892	31.8	36.8	37.4	51.6	63.4	75.9	76.4	76.2	66.2	55.8	43.8	33.4	54.1
1893	24.6	34.0	40.3	52.6	61.4	72.4	77.0	74.6	66.6	57.0	43.6	38.6	53.6
1894	37.5	34.4	48.2	52.4	65.3	73.0	77.6	73.2	70.6	57.4	43.4	37.7	55.9
1895	31.3	26.4	40.6	52.8	62.4	74.2	73.1	77.1	72.3	53.4	47.1	39.2	54.2
1896	33.6	36.0	38.1	56.6	69.0	71.3	77.8	76.2	68.4	54.8	51.0	36.4	55.8
1897	31.6	36.8	45.0	53.0	62.8	70.1	76.9	74.3	68.8	58.2	46.3	38.6	55.2
1898	37.0	35.2	48.6	51.2	63.9	73.8	78.7	77.4	71.4	58.0	44.6	36.2	56.3
1899	33.4	28.4	41.7	53.8	64.5	75.2	77.6	75.6	67.0	58.7	47.4	37.4	55.1
1900	36.2	33.1	38.6	55.0	65.2	73.4	80.1	80.4	73.8	62.0	49.6	37.2	57.0
1901	34.9	29.5	43.8	50.7	61.8	72.6	80.4	76.7	68.4	56.7	41.8	35.2	54.4
1902	31.6	30.4	46.7	53.3	64.6	72.3	77.8	73.6	67.2	58.6	51.9	34.8	55.2
1903	33.6	37.8	49.6	54.4	65.2	67.2	77.2	71.9	68.2	58.4	43.2	33.0	55.0
1904	27.4	28.6	41.0	49.9	65.7	71.4	75.6	73.6	68.2	54.8	43.8	31.6	52.6
1905	30.8	27.3	44.6	54.2	65.1	72.2	77.0	74.2	69.0	58.2	45.8	38.4	54.7
1906	40.2	34.2	37.6	56.1	65.1	73.6	75.9	76.8	72.4	56.2	47.3	36.3	56.0
1907	36.5	28.8	47.0	47.8	59.0	66.7	76.6	73.6	69.9	53.2	45.4	39.0	53.6
1908	35.0	31.2	47.1	56.5	65.1	73.6	79.0	74.2	68.4	59.8	46.4	37.9	56.2
1909	35.6	42.6	41.8	53.9	64.5	74.1	76.0	74.4	67.7	54.8	51.5	33.2	55.8
1910	34.0	34.8	49.8	58.2	62.2	70.4	78.9	74.4	71.6	60.8	42.6	31.2	55.7

TABLE 2—*Continued*

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ann'l
1911	38.4	36.6	40.8	51.0	69.4	73.4	79.2	76.2	70.4	58.3	43.8	41.5	56.6
1912	25.8	31.5	40.2	54.6	65.4	71.4	76.5	74.4	70.6	60.6	48.6	40.6	55.0
1913	43.5	36.2	48.8	55.6	64.9	73.7	78.6	75.2	68.4	59.6	49.0	41.4	57.9
1914	37.6	30.2	39.6	53.0	68.0	74.4	76.3	77.0	66.8	61.4	47.0	33.4	55.4
1915	36.0	38.4	39.4	59.2	62.2	70.6	76.9	74.2	71.5	59.6	47.0	35.4	55.9
1916	39.5	33.6	37.0	52.6	66.6	69.4	78.0	76.8	67.6	57.6	47.3	36.0	55.2
1917	35.3	32.2	43.2	53.8	59.2	73.0	77.2	76.4	64.5	52.6	44.6	28.4	53.4
1918	24.2	35.4	47.2	53.0	69.3	70.9	75.4	78.3	65.0	60.8	47.2	41.9	55.7
1919	38.2	37.6	46.2	52.9	64.9	73.4	78.0	74.6	70.4	63.0	47.4	33.2	56.6
1920	28.6	32.8	44.8	52.8	60.8	72.6	76.0	74.8	69.8	63.1	47.1	39.8	55.2
1921	37.0	39.0	54.6	58.6	63.1	75.0	80.2	73.9	74.5	57.8	48.1	37.2	58.2
1922	32.2	38.4	44.8	55.8	67.2	75.1	77.0	74.1	70.8	60.6	49.0	37.4	56.9
1923	36.6	32.4	44.5	53.6	63.8	76.7	76.7	74.8	70.4	57.4	46.4	45.4	56.6
1924	34.8	34.6	43.0	52.2	60.2	71.2	76.1	76.0	65.4	59.4	47.0	36.8	54.7
1925	33.0	41.8	46.1	56.4	61.2	78.7	77.2	74.7	73.4	52.7	45.4	37.3	56.5
1926	34.5	35.6	39.8	51.6	64.5	69.7	77.4	76.8	69.6	58.0	45.6	33.6	54.7
1927	34.2	42.1	47.4	51.8	63.2	69.3	77.2	71.0	70.3	61.4	51.6	40.0	56.6
1928	36.3	37.6	43.8	51.9	63.0	71.0	79.2	77.8	65.8	60.7	50.3	41.0	56.5
1929	35.4	35.6	50.2	57.4	64.3	73.3	77.4	74.4	70.4	56.2	48.3	38.7	56.8
1930	36.2	42.0	45.2	52.6	68.4	76.2	80.6	77.6	76.2	57.6	47.5	37.0	58.1
1931	38.1	39.6	41.9	53.8	65.2	74.5	81.0	77.0	76.0	63.4	54.7	45.7	59.2
1932	47.4	42.8	40.3	52.8	64.4	73.6	78.3	78.4	71.1	58.6	45.8	40.9	57.9
1933	43.5	38.0	42.8	54.7	67.1	76.0	77.2	77.0	73.0	58.0	45.2	38.2	57.6
1934	39.0	24.3	40.5	53.8	67.2	77.8	81.4	74.7	71.3	57.0	50.5	37.7	56.3
1935	33.2	35.0	49.4	52.6	62.2	73.6	79.4	76.8	67.3	58.5	50.4	32.8	55.9
1936	30.8	29.7	48.8	51.8	67.8	73.2	78.6	78.2	71.4	60.0	45.6	40.8	56.4
1937	43.5	36.7	41.9	53.2	66.8	75.2	78.3	78.4	67.2	56.2	47.6	38.0	56.9
1938	36.2	40.4	49.2	56.7	63.6	73.1	79.1	80.0	68.0	59.8	50.4	39.4	58.0
1939	38.0	41.8	45.2	53.4	68.4	75.5	77.2	80.0	71.2	59.6	47.4	40.8	58.2
1940	26.0	37.4	40.0	50.2	64.4	75.0	78.8	73.5	68.2	55.8	48.4	43.0	55.1
1941	34.7	34.0	40.1	60.4	68.3	73.6	78.4	77.0	73.2	65.1	52.0	42.5	58.3
1942	35.8	34.4	47.0	58.8	69.0	74.4	79.7	75.4	71.2	60.7	49.0	34.9	57.5
1943	35.0	38.8	44.6	50.6	66.8	79.8	78.4	79.1	68.5	56.6	47.0	37.3	56.9
1944	38.2	38.0	41.8	53.0	70.6	74.7	79.7	77.4	70.6	57.8	48.0	34.8	57.0
1945	30.4	38.6	55.7	58.4	63.2	75.0	77.0	75.8	72.6	58.7	49.6	33.4	57.4
Mean	34.8	35.6	43.3	53.7	64.7	73.3	77.8	75.6	69.3	58.1	46.9	37.4	55.9

The annual mean temperature is 55.9° F.; the average monthly temperature ranges from 34.8° F. in January to 77.8° F. in July.

The precipitation and temperature data for the weather station at Baltimore are given in Tables 1 and 2.

GENERAL FEATURES

PHYSICAL DIVISIONS

The Baltimore area is within the Atlantic slope, a region that extends from the Allegheny Mountains to the Atlantic Ocean. This region has been divided into several physiographic provinces (fig. 1); the Baltimore area lies within two of these provinces, the Piedmont Plateau and the Coastal Plain.

The Atlantic Coastal Plain is the relatively low part of the Atlantic slope extending from Cape Cod south through Florida. It is bounded on the east by the edge of the Continental Shelf in the Atlantic Ocean, and on the west by the Piedmont Plateau. In the Baltimore area the Coastal Plain is generally underlain by soft, unconsolidated, easily eroded sediments. In a few localities the sediments have been cemented to form hard, resistant rock like that capping the hills on the southwest side of the Fairfield-Curtis Bay districts. (See Pl. 19 A.) The land surface of the Coastal Plain is characterized by low hills, shallow valleys, and flat plains. In the northern half of the area included in this report, the Coastal Plain is characterized by long, narrow peninsulas, called necks, that extend southeast to Chesapeake Bay. These necks are separated by bodies of water generally called rivers but, as they are valleys that have been "drowned" by sea water, they are really estuaries.

The Piedmont Province or Plateau is the area west of the Coastal Plain and extends to the foot of the Appalachian Mountains. The Piedmont Plateau is higher and generally more rugged than the Coastal Plain. Its subsurface extension eastward forms the floor upon which the Coastal Plain sediments were deposited (Clark and Mathews, 1906, p. 74).

The Piedmont Plateau is underlain by hard crystalline rocks that are more resistant to erosion than the unconsolidated sediments of the Coastal Plain. However, because weathering and erosion have gone on for a long time in the Piedmont Plateau, their effects are pronounced and in general the upper part of the rocks is decomposed and disintegrated and covered by soil. The land surface is gently rolling except near the eastern boundary. There the valleys are deep and rugged and are characterized by exposures of hard, fresh crystalline rock, and the streams contain many falls and rapids (Pl. 19 B). The boundary of the two physiographic provinces is called the "Fall Line." This name is misleading, however, as the boundary is a zone rather than a line, with long ridges of Coastal Plain sediments that extend several miles onto the Piedmont Plateau and in many places the falls and rapids extend for a distance of 15 to

20 miles (Knopf, 1929, pp. 60-61). Thus the boundary between the two physiographic provinces is indefinite. In this report it is considered arbitrarily to be along the Baltimore and Ohio Railroad from Washington through Baltimore to Havre de Grace.

The major streams, which are, from north to south, the Susquehanna, Gunpowder, Patapsco, and Patuxent Rivers, flow from the Piedmont Plateau across the Coastal Plain and empty into Chesapeake Bay. On the Piedmont Plateau these streams are characterized by deep valleys and relatively swift currents; on the Coastal Plain, however, they are largely tidal and are wide and sluggish.

GENERAL GEOLOGY

The rocks in the Baltimore area may be classified into two general groups, the hard crystalline rocks exposed in the Piedmont Plateau, and the soft unconsolidated sediments that lie above the crystalline rocks in the Coastal Plain. The crystalline rocks are composed chiefly of gabbro, granite, gneiss, schist, and smaller amounts of quartzite and marble. The age of some of them is uncertain, but as their age is not significant with respect to their water-bearing characteristics, all the crystalline rocks are considered in this report to be of pre-Cambrian age. The unconsolidated sediments, which are chiefly of Cretaceous and Pleistocene age, consist mostly of sand, gravel, and clay.

The hard crystalline rocks are much older than the unconsolidated sediments and have been more affected by geologic processes. Intrusions of molten rock and intense pressure from folding have changed much of the rock from its original character. After the crystalline rocks were formed there was a long period in which they were eroded to a moderately level plain that extended for a long distance beyond the present shore line. Thus at the beginning of Cretaceous time, before the deposition of Coastal Plain sediments in the Baltimore area, the land surface was moderately level and was not far above sea level (Stephenson, Cooke, and Mansfield, 1933, p. 6). Early in Cretaceous time the area of the Coastal Plain was lowered and at the same time the Piedmont Plateau area was elevated. The increased gradient of the land surface enabled streams to erode large quantities of material from the Piedmont area and to transport it to the depressed area to the east. Although the Coastal Plain area lowered, it remained above sea level in the Baltimore area, as the sediments of Cretaceous age, typically irregularly bedded and lenticular, are nonmarine and apparently were deposited mostly by streams or in lakes. After the coarse sediments of the lowest formation, the Patuxent, were deposited they were eroded and the Arundel clay was deposited. The clay was laid down chiefly in old drainage depressions, but it attained sufficient thickness to overlap the sediments of the Patuxent formation and form a sheet deposit (Clark, Bibbins, and Berry, 1911, p. 66).

The Arundel clay is considered to have been deposited under swamp conditions, as it contains lignitic material and tree trunks, of which some have been found erect with roots intact (Clark, Bibbins, and Berry, 1911, p. 83). Following its deposition there was a period of erosion, after which the Piedmont area was elevated again, so that the streams were able to transport the predominantly coarse sediments that comprise the Patapsco formation.

After a long period of erosion the sediments, consisting mostly of gravel and clay, of the Pleistocene epoch were deposited upon the eroded surface of the Cretaceous and pre-Cambrian rocks in the Baltimore area. Although the sediments of the Pleistocene epoch have been divided into several units, chiefly on the basis of the altitude of the terraces formed by the Pleistocene sea, for convenience of discussion these sediments have been considered in this report as comprising two units, the upland and lowland deposits.

In general the geologic structure of the area is simple. The sediments of Cretaceous and Pleistocene age form a wedge-shaped mass lying on the east-sloping crystalline-rock floor (fig. 3); thus the thickness of the sediments increases progressively toward the east. The strike of the Cretaceous formations is approximately northeast; consequently the formations crop out as bands of irregular width extending northeast parallel to the boundary between the Piedmont Plateau and the Coastal Plain (Pl. 2). One may picture the area as being underlain by layers of sedimentary formations that slope gently toward the southeast and whose beveled edges crop out as northeast-trending bands.

GENERAL HYDROLOGY

The occurrence of ground water is controlled largely by the physical character and structure of the geologic formations; hence, in the Baltimore area, where the relatively dense and impermeable crystalline rocks of the Piedmont Plateau contrast with the porous and permeable unconsolidated sediments of the Coastal Plain, ground water may be considered as occurring under two widely different sets of conditions.

The relatively few openings in which water is stored and transmitted in the crystalline rocks are largely secondary—they were formed by earth movements and weathering. The porous and permeable zones in these rocks are not uniform and gradually disappear with depth.

In contrast to the relatively dense crystalline rocks, the sands and gravels of Cretaceous and Pleistocene age in the Coastal Plain are very porous and permeable. Although these sediments are irregularly bedded and lenticular, the lenses of sand and gravel are sufficiently interconnected to form several relatively uniform and widespread ground-water reservoirs.

The source of practically all the ground water in the Baltimore area is precipitation. The transmission of water from the interior of the earth is negligible. In the crystalline rocks of the Piedmont Plateau a part of the

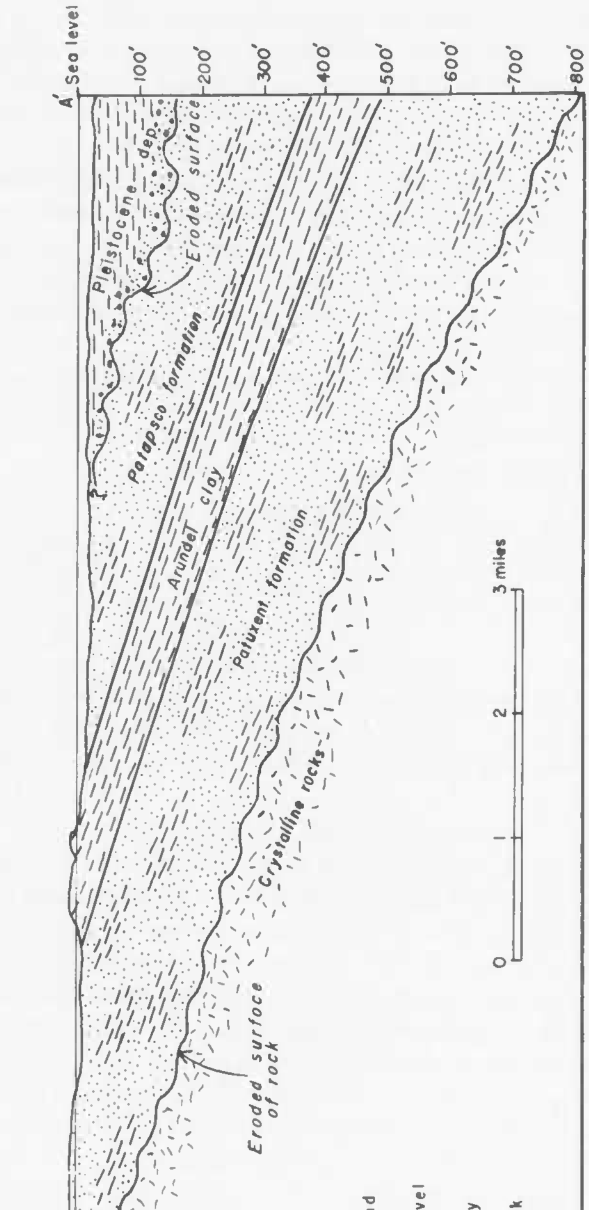


FIGURE 3. Generalized geologic section along line A-A′ shown on figure 2

water from precipitation enters the openings in the rocks where it is temporarily stored. It gradually moves toward the valleys where it is discharged into streams or is dissipated by evaporation and transpiration. Except locally the ground water in the crystalline rocks occurs under water-table conditions—that is, it is not confined beneath impermeable material.

The ground water reservoirs in the Coastal Plain are replenished chiefly from precipitation on the exposed edges or outcrops of the water-bearing formations. Except in these areas of outcrop the water in the water-bearing formations in the Coastal Plain occurs under artesian conditions—that is, the water passes down the dip beneath impermeable clay and becomes confined under pressure.

A summary of the rock formations and their water-bearing properties is given in Table 3.

GEOLOGIC FORMATIONS AND THEIR WATER-BEARING PROPERTIES

PRE-CAMBRIAN

CRYSTALLINE ROCKS

Although most of the crystalline-rock area of Maryland is outside the area of this report, the general features of these rocks were observed in the vicinity of Baltimore in order to determine the hydrologic relation of the water in the crystalline rocks with that in the unconsolidated sediments in the Coastal Plain.

DISTRIBUTION AND CHARACTER

The crystalline rocks of the Piedmont Plateau and the rock floor upon which the sediments in the Coastal Plain were deposited are exposed along the western edge of the Baltimore area (Pl. 2), where, owing to their resistance to erosion, they generally lie at an altitude higher than the sediments in the Coastal Plain. The rocks consist chiefly of gabbro, granite, gneiss, and schist, with smaller amounts of quartzite, marble, and granite pegmatite. Most of these rocks have been classified as pre-Cambrian (Maryland Geological Survey, 1925) but later investigations (Mackin, 1935, pp. 356-380; Miller, 1935, pp. 715-756; Cloos and Hershey, 1936, pp. 71-80; and Cloos and Hietanen, 1941) indictate that at least a part of them may be of Paleozoic age. For convenience, however, these rocks are treated as a unit in this report and arbitrarily are considered of pre-Cambrian age. An excellent summary of the geologic units in the Piedmont Plateau has been given by Cloos (1937).

A large part of the crystalline rocks originally were sedimentary, but intense folding and igneous activity have metamorphosed and recrystallized them so that their original texture has been changed greatly and, for the most part, the

TABLE 3

Generalized Section of Geologic Formations in the Baltimore Area

Era	System	Series	Formation	Thickness (feet)	Physical character	Water-bearing characteristics
Cenozoic	Quaternary	Pleistocene	Lowland deposits	0-150 +	Gray clay, sand, gravel, and cobbles.	Generally yield adequate supplies of water to shallow domestic wells. May yield large quantities of water where deposits are thick; however, heavy pumping probably would cause salt-water contamination from adjacent estuaries.
			Upland deposits	0-25 ±	Clay, sand, and gravel.	Not an important water-bearing formation; yields small supplies of water to dug wells in some favorably situated places.
Mesozoic	Cretaceous	Upper Cretaceous[a]	Raritan formation	100(?)	Varicolored clay, sand, and gravel (lithologically similar to the underlying Patapsco).	Yields ample supplies of water for domestic purposes in southern part of area. Water usually contains large amount of iron.
			Patapsco formation	300(?)	Lenticular beds of sand, clay, and gravel. May be divided locally into an upper and a lower part.	Contains very permeable beds of sand and gravel that yield as much as 900 gallons a minute to industrial wells. Water generally is high in iron. Contaminated with salt water in many parts of the industrial area in and near Baltimore.
			Arundel clay	25-200	Dark-gray to red clay, with some indurated "iron ore" rock.	Not a water-bearing formation; is a confining layer.
		Lower Cretaceous	Patuxent formation	150-250	Lenticular beds of sand, gravel, and clay.	The most important water-bearing formation in the Baltimore area. Yields large supplies of water for industrial use.
	Pre-Cambrian				Hard crystalline rock, chiefly schist, granite, gneiss, and gabbro.	Yields adequate supplies of water for domestic use in outcrop area. Not an important water-bearing formation in the Coastal Plain area.

[a]The Patapsco and Arundel formations have generally been classified as Lower Cretaceous, though in 1921 Gilmore considered them Upper Cretaceous on the basis of vertebrate fauna in the Arundel formation. Gilmore's conclusion was further substantiated by Anderson and Vokes in 1948 (Maryland Department of Geology, Mines and Water Resources, Bulletin 2) by the finding of an Upper Cretaceous molluscan fauna in beds which on the basis of heavy mineral correlation were believed to be low in the Patapsco or in the Arundel. The Upper Cretaceous correlation was accepted in 1950 by the United States Geological Survey in a report by C. Wythe Cooke on the Sedimentary Deposits of Prince Georges County (to be published by the Maryland Department of Geology, Mines and Water Resources).

bedding planes have been practically obliterated. The relation of the various rock types to each other is complex; however, the granite is considered to consist of igneous intrusives with associated dikes of granite pegmatite and aplite, and the gabbro is a great intrusive mass with many associated dikes (Knopf and Jonas, 1929, p. 106). The gneiss in and near Baltimore probably was derived from sediments that were altered by injections of magma (Knopf and Jonas, 1929, p. 151).

WATER-BEARING PROPERTIES

With the possible exception of the gneiss, schist, and quartzite, nearly all the crystalline rocks, in their original state, were hard and dense and contained practically no openings in which ground water could occur. Intense folding and other crustal movements, however, created many openings in the form of schistosity, joints, shear zones, and other fractures in which the water could accumulate (Pl. 20 A). Although the structural openings form a large part of the storage space for ground water, it is likely that circulating ground water enlarged the openings by slowly decomposing and dissolving some of the minerals in the rocks. The degree of decomposition is greater in some localities than in others because some rock types are more susceptible to decomposition than others and because the rate of ground-water circulation is not uniform. In the Piedmont Plateau the circulation is greater near the streams, which are the major localities of natural discharge of ground water. Thus the development of porous and permeable zones in the crystalline rocks depends chiefly on the number and size of the structural openings—joints, shear zones, and other fractures—and the decomposition and solution of the rock by circulating ground water. The rate of circulation is controlled to some extent by the type of rock, the configuration of the land surface, and the proximity to streams into which ground water is discharged. It is, therefore, not surprising that the crystalline rocks form a very irregular and inhomogeneous water-bearing formation in which wells have a wide range of yields.

Wells drilled in granite and granite pegmatite generally have higher yields than wells drilled in gabbro. This probably is due to the presence of larger openings, formed in part by the decomposition of feldspar, a mineral constituent of granite and granite pegmatite that decomposes more readily than the basic minerals that make up gabbro. This feature was experienced in the drilling of well Bal-Ef 20.[1] This well penetrated 490 feet of hard, dense gabbro without obtaining water; however, decomposed rock, apparently granite pegmatite, that yielded 24 gallons of water a minute was penetrated between

[1]The locations of wells prefixed by a county symbol, for example Bal (Baltimore County), are shown on Plate 3; the locations of wells in the Sparrows Point district are shown on Plate 4. All wells prefixed by numbers and direction symbols, for example 2S2E-5, are within the Baltimore city limits and their locations are shown on Plate 1.

depths of 490 and 492 feet. The drill cuttings from this interval were composed largely of quartz grains, indicating that the feldspar had been decomposed.

The large yield (about 150 gallons a minute) of well 3N2W-4 indicates that the granite at this locality is highly decomposed at some levels. Well 3N2W-2, which is within a few hundred feet of well 3N2W-4, was surveyed by means of a well-logging device that measures the relative electrical resistance of the rocks and the small voltages (potential) that may occur between different types of rock and fluid. The electrical resistance of a rock is largely dependent on the amount and conductivity of water contained in the rock; as the chemical character of the water in the crystalline rocks is relatively uniform, the electrical resistance and the fluid content or porosity of the rock are closely related,[2] the resistance decreasing with an increase in fluid content.

Figure 4 shows a record of the electrical resistance and potential of the water-bearing rocks penetrated in well 3N2W-2. The resistance curve shows that the rocks are "weathered" from the land surface to a depth of 27 feet. The interval between 27 and 39 feet is relatively dense but the rocks below, from 39 to 45 feet, appear to be well decomposed, as their resistance is less than that of the rocks from the land surface to 27 feet. The differences in voltage shown by the potential curve in Figure 4 cannot be readily explained; it is likely that they have little or no value in showing the relative porosity of the crystalline rocks penetrated by this well.

An electrical log also was made of well Bal-Eb 1, on the southwest side of Liberty Road, 4 miles northwest of the Baltimore city limits (fig. 4). The resistance curve shows that the rocks are well decomposed in the "weathered" zone from the land surface to a depth of 55 feet. From 55 feet to a depth of 130 feet, the limit of the electrical log, the resistance is higher except for thin zones with moderately low resistance. The moderately low resistance probably is caused by the presence of slightly decomposed rock or small fractures. Core samples from this well show that in general, the zones of high resistance correspond to hard, dense gabbro or quartz; the low resistances appear to be zones of fracture or decomposed rock. As the cores from many intervals were not recovered, a complete comparison between the rock core and the resistance value could not be made. Most of the levels from which no core was recovered during the drilling were in the upper part of the well, where the rocks are softer and more highly decomposed.

The decomposed rocks that generally occur near the land surface form a porous and, in many places, permeable water-bearing zone. This is the so-called "weathered" zone; however, this term is not strictly correct for rocks below this zone also are weathered though to a lesser degree. The degree of

[2]For a discussion of the principles of electrical logging of wells, see pages 150-152.

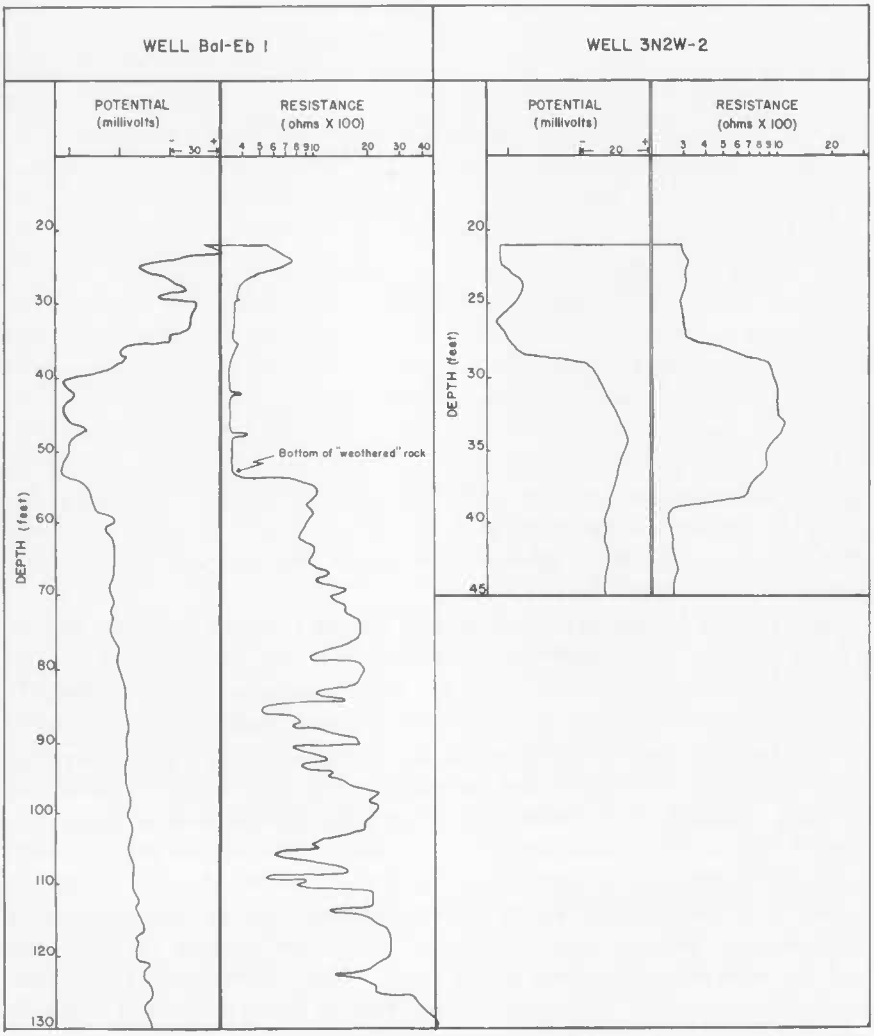


FIGURE 4. Graph showing electrical logs of two wells penetrating crystalline rocks

decomposition may change abruptly; for example the electrical log of well Bal-Eb 1 (fig. 4) shows an abrupt increase in resistance at the bottom of the "weathered" zone at a depth of 55 feet. The weathered zone has a wide range in thickness, being absent in those places where fresh crystalline rocks crop out, but as much as 50 to 75 feet thick in other places.

Few data are available to evaluate the permeability and porosity of the crystalline rocks beneath the Coastal Plain where they are overlain by thick deposits of sand, gravel, and clay of Cretaceous or Pleistocene age. Except near the western edge of the Coastal Plain, where the unconsolidated sediments are relatively thin, only a few wells have been drilled through the sediments to obtain water from the underlying crystalline rocks. Drillers' logs of most of these wells show a thin zone of decomposed rock immediately underlying the sediments, but it is not sufficiently permeable to yield large supplies of water. Although joints and other fractures probably are in the crystalline rocks beneath the Coastal Plain sediments, they probably have not been enlarged to any great extent by ground-water circulation. In comparison to the Piedmont Plateau, where the crystalline rocks are exposed and water from precipitation is added frequently, the water in the crystalline rocks below the Coastal Plain sediments moves very slowly and is relatively "stagnant." This slower rate of ground-water circulation accordingly causes less rock decomposition than in the Piedmont Plateau.

Yield of Wells

The best available index of permeability of the crystalline rocks in the Baltimore area is given by the reported yields of wells; but such a method of analysis may be misleading and inaccurate, as some wells are not pumped at their maximum capacity and others would have higher yields if the pumps were set at a greater depth or if the wells were drilled deeper. Furthermore, it is somewhat meaningless to evaluate the water-bearing properties of the crystalline rocks on the basis of the yields of wells scattered at random throughout the crystalline-rock area. The permeability and porosity of the crystalline rocks in that area are determined largely by the geologic structure, the type of rock, and the topography; consequently a detailed study of the structural elements, for example as described by Cloos (1937), together with the relation of the topography and rock type to the water-bearing properties, would be necessary for a systematic mapping of the ground-water resources of the crystalline-rock area. However, as such a study would be lengthy and as the largest ground-water developments in the Baltimore area are on the Coastal Plain, the crystalline-rock area was studied only by reconnaissance. It is necessary, therefore, to depend largely on a statistical analysis of the yields of wells in crystalline rocks to indicate their general water-bearing properties, but the limitations of such an analysis should be recognized.

The reported yields of crystalline-rock wells in and near Baltimore probably represent more nearly their maximum capacity than do the yields reported for similar wells in rural areas, as most of the wells in and near the city were drilled for industrial purposes requiring relatively large supplies of water. The reported yields from 106 crystalline-rock wells in Baltimore are arranged according to frequency in Figure 5. This statistical analysis shows that the average or mean yield is 50 gallons a minute and the median yield is 35 gallons a minute. The median yield probably is more significant than the mean, as it is not affected appreciably by the few extremely small or large yields. The mode, which is the most usual or typical value (Arkin, 1939, p. 23), is 10 gallons a minute. The reported yields range from 0 to 350 gallons a minute; however, the three wells reported to yield 350 gallons a minute were omitted from Figure 5 in order to condense the graph. It is likely that these three wells (1S3E-23 to 25) may draw water from cavernous limestone because wells 1S3E-16 and 17, which are about 2,000 feet to the south, are reported to have penetrated limestone. Limestone, however, is not common within Baltimore; consequently such high yields in the crystalline-rock area are exceptional.

No consistent relation was found between yield and rock type, except that, in general the yields from wells ending in schist and gabbro are lower than those of wells in gneiss and granite. The type of rock appears to be much less important than the number and size of structural openings and the configuration of the land surface in determining yield.

Plotting the reported yields of wells against the well depths shows a widespread scattering of points and only a vague trend toward increased yield with increased depth. Obviously the yield should increase at least slightly with depth as additional water-bearing openings add to the supply encountered at a shallower depth. However, such a graph is subject to error, in that many wells obtain their largest supply of water at a shallow depth but the well is drilled deeper in hopes of further increasing the supply. Inasmuch as the depths at which water was encountered are reported only rarely, it can only be assumed that all the water was encountered at a depth equal to the well depth. If the reported yields could be plotted against the depth at which water was encountered, it probably would show that the yields generally increase appreciably down to a depth of about 200 feet, then increase slightly to a depth of 300 to 400 feet; below this depth there generally would be no marked increase in yield.

Only a few wells draw water from the crystalline rocks where they are covered by a thick blanket of Coastal Plain sediments. Well Bal-Gf 10 (Sparrows Point district) penetrated 53 feet of hard crystalline rocks from 658 to 711 feet below the land surface, without obtaining any water. Wells 2S3E-6 and 7 (Canton district), which presumably end in the crystalline rocks, are reported to yield 40 and 50 gallons a minute, respectively. The crystalline rocks there are covered by about 200 feet of unconsolidated sediments. Other wells have been drilled a short distance into the crystalline rocks after penetrating the unconsolidated sediments, but practically all those wells are screened opposite the overlying sand and gravel of Cretaceous age from which much larger yields can be obtained.

In summation, wells drilled in the crystalline rocks in the Baltimore area

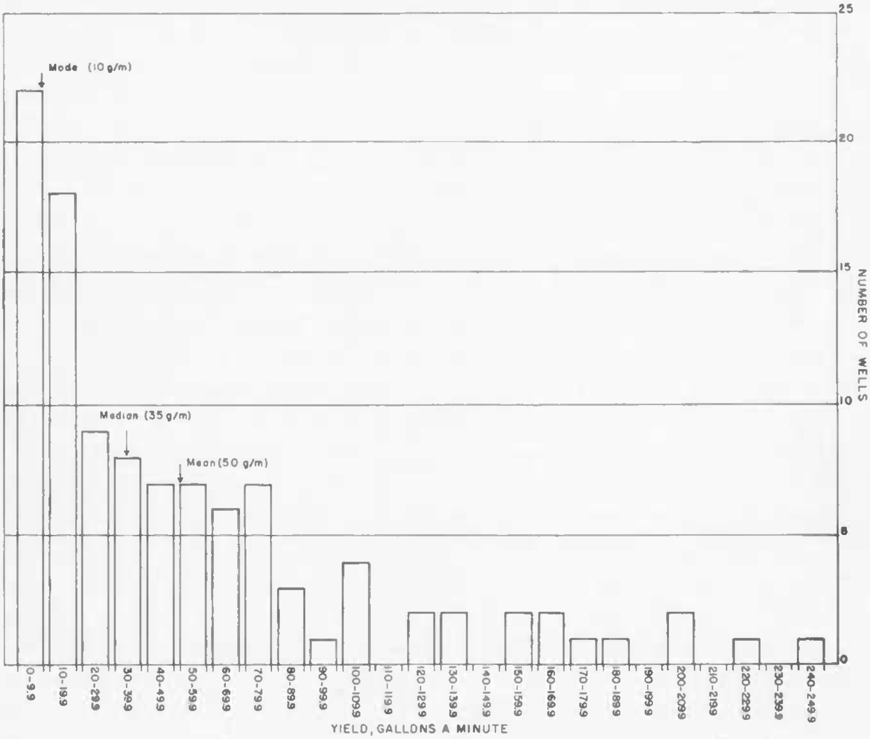


FIGURE 5. Frequency distribution of yields from 106 wells ending in crystalline rocks in Baltimore

are likely to yield from 10 to 35 gallons a minute, although there is a possibility that they may be "dry," but also that they may have large yields of as much as 250 to 350 gallons a minute. The crystalline rocks beneath thick Coastal Plain sediments have such a low permeability in comparison to the water-bearing sand and gravel in the overlying sediments that the crystalline rocks cannot be classed as an important aquifer in the Coastal Plain.

CONFIGURATION OF CRYSTALLINE-ROCK SURFACE BENEATH THE COASTAL PLAIN SEDIMENTS

As the crystalline-rock floor forms the bottom of the productive water-bearing formations of the Coastal Plain sediments, it is important to know its depth beneath the land surface and its surface configuration. Plate 5 shows by contours, based on well-log data, the altitude of the crystalline-rock surface beneath the Coastal Plain sediments in the Baltimore area. As the land surface in the Coastal Plain is relatively level and not far above sea level, the altitude contours indicate the approximate thickness of the unconsolidated sediments overlying the crystalline rocks.

The bedrock surface slopes generally southeast at the average rate of about 85 feet to the mile; in detail, however, the contours show that the surface slopes as much as 125 to 150 feet to the mile near the western edge of the Coastal Plain in the Harbor, Highlandtown, and Canton districts, then the slope decreases to about 60 to 75 feet to the mile in the Fairfield, Curtis Bay, and Dundalk districts, and then steepens to about 90 feet to the mile to the southeast. The average slope of 85 feet to the mile in the Baltimore area is about the same as that of the crystalline-rock surface beneath the Coastal Plain sediments in Long Island, N. Y., where it is 75 to 80 feet to the mile (De Laguna and Brashears, 1946, p. 11).

According to the available data, the bedrock surface in the Baltimore area appears to be rather featureless, but one shallow depression or valley in the bedrock extends south from the Highlandtown district for about 2 miles. Doubtless if additional information were available other surface irregularities could be detected.

The decreased slope of the bedrock surface in the Fairfield, Curtis Bay, and Dundalk districts appears to form a northeast-trending terrace-like feature about 2 miles wide. Such a feature in the bedrock surface apparently is not rare; for example, the bedrock surface east of Petersburg, Va., forms a nearly horizontal terrace (Cederstrom, 1945, p. 16). The origin of this terrace-like feature in the Baltimore area might be ascribed to erosion near an old shore line; if so, it could not have been associated with the deposition of the Lower Cretaceous sediments, which immediately overlie it, as those sediments in the Baltimore area are of continental origin. The terrace could have been derived from the beveling of a fault block associated with an uplift of the Piedmont Plateau before the deposition of the sediments of the Patuxent formation. A flattening of the surface might have resulted if a fault formed a westward-facing scarp in the bedrock surface and then was eroded. It has been suggested previously that faulting may be the cause of the steep eastward slope of the bedrock surface in several places near the boundary between the Piedmont Plateau and the Coastal Plain. Cederstrom (1945, pp. 17-18) has suggested that faulting or pre-Cretaceous erosion may explain the steep slope of the bedrock surface, which, at Quantico, Va., slopes 200 feet in a horizontal distance of 1,500 feet. McGee (1886, pp. 545-646) concluded from his studies of the geology near the head of Chesapeake Bay that the rocks were displaced along the Fall Line in that area. Several carefully constructed vertical sections across the Fall Line in Maryland and elsewhere are reported to indicate displacements (Clark, Bibbins, and Berry, 1911, p. 85).

Thus there would seem to be evidence suggesting that faulting, with downthrow to the east, has played a part in the formation of the steep slopes of the bedrock along some parts of the Fall Line. If so, it would seem reasonable to expect associated faults, with downthrow to the west, that would form flatter instead of steeper slopes.

CRETACEOUS SYSTEM

LOWER CRETACEOUS SERIES

PATUXENT FORMATION

The Patuxent formation, named for its development in the upper valleys of the Little and Big Patuxent Rivers (Clark and Bibbins, 1897, p. 481), is the basal formation of the Coastal Plain sediments in the Baltimore area. The sediments of that formation, the most important aquifer in the Baltimore area, were deposited on the southeastward-sloping crystalline-rock floor.

DISTRIBUTION AND CHARACTER

The formation crops out (Pl. 20 B) in an irregular belt from about 1 to 3 miles wide, extending in a northeasterly direction along the western edge of the Coastal Plain (Pl. 2). The continuity of the outcrop is broken by Gunpowder Falls, and the Patapsco and Susquehanna Rivers. The western part of the outcrop has been well dissected by streams; hence there are many outliers and "peninsulas" of the formation west of the main outcrop belt. The land surface formed by the Patuxent formation is hilly in the western part of the outcrop belt but relatively level in the eastern part.

In general the formation is not well exposed except in sand and gravel pits where the soil cover or alluvial overburden has been removed. Owing to the scarcity of good exposures, much of the information on the lithology was obtained from drillers' logs of water wells and from examination of well cuttings.

The exposures in the outcrop area show a series of irregular and lenticular beds of sand, gravel, sandy clay, and clay with thin lenses or masses of sandstone firmly cemented by iron oxide to form indurated rock ledges or seams. (See Pls. 21 and 22.) Much of the sand is arkosic and contains disseminated kaolin, a white clay derived from the decomposition of feldspar. Some beds of sand contain pebbles or small balls of clay. The sand and gravel are commonly cross-bedded, and the character of the sediments changes abruptly within a short vertical or horizontal distance. The basal part of the formation is made up largely of coarse material—pebbles, cobbles, and mica particles reworked from the underlying crystalline rocks. In some places these coarse clastics are cemented by clay to form a conglomerate (Pl. 22 B). The grains of sand and gravel consist mostly of quartz and generally are subangular to subrounded.

The formation has no single characteristic color; it comprises sediments colored in many shades of red, brown, gray, and lavender; but, except in fresh exposures, the colors are not particularly vivid. The sand and gravel generally are light gray to buff, and the clay is red to gray; but where the clay consists chiefly of kaolin it is white. Some clay, however, has a mottled coloring of red, gray, and white, and in a few places, owing to an abundance of finely disseminated carbonaceous material, the clay is black (Clark, Bibbins, and Berry, 1911, p. 60).

The sediments of the Patuxent formation generally are unfossiliferous, but a large number of plant specimens have been collected at a few localities, and the dinosaurian fauna of the overlying and closely related Arundel clay was probably in existence when the sediments of the Patuxent formation were being deposited (Clark, Bibbins, and Berry, 1911, pp. 63-64). Many of the plant fragments have been lignitized; these include tree trunks, some of which have been found in an erect position (Clark, Bibbins, and Berry, 1911, p. 60.)

It is difficult to determine the thickness of the Patuxent formation in the outcrop area from measured exposures; however, in and near Baltimore, logs of wells and information from exposures indicate that the thickness in the outcrop area is about 150 feet.

Drillers' logs of water wells and well cuttings have provided much valuable information on the lithologic character of the Patuxent formation where it is covered by younger sediments. The well data show that the formation is composed chiefly of beds or lenses of sand, gravel, sandy clay, and clay in varying proportions. The proportion of different types of sediments encountered in wells penetrating the Patuxent formation is given in Table 4.

The thicknesses of the lithologic types given in Table 4 are only ap-

TABLE 4

Thickness, In Feet, of Different Types of Sediments Encountered In Wells Penetrating the Patuxent Formation In the Baltimore Industrial Area

(Data obtained from drillers' logs)

Well	Sand and/or gravel	Clay and/or hard rock	Sandy clay	Sand and clay	Thickness of formation penetrated (feet)
(Harbor district)					
2S1E-3	36	115	0	0	151
3S1E-15	79	37	6	0	122
3S2E-1	13	75	9	0	97
(Average)	43	75	5	0	123
(Highlandtown district)					
1S3E-7	69	40	13	55	177
1S3E-8	30	75	59	21	185
1S3E-19	61	77	0	0	138
1S4E-2	87	68	14	0	169
(Average)	62	65	21	19	167
(Canton-Dundalk district)					
2S3E-17	102	35	0	0	137
2S4E-1	64	46	0	21	131
2S4E-12	34	53	10	0	97
3S3E-34	46	11	16	0	73
3S5E-30	104	33	34	9	180
Bal-Fe 16	65	90	4	7	166
(Average)	69	45	11	6	131
(Fairfield district)					
4S3E-4	39	1	9	10	59
5S2E-20	79	45	51	12	187
5S3E-2	80	62	5	1	148
5S3E-17	68	28	83	0	179
5S3E-45	87	118	26	0	231
5S3E-46	85	43	70	8	206
(Average)	73	49	41	5	168
(Curtis Bay district)					
6S2E-1	97	10	19	0	126
6S2E-3	134	26	9	4	173
6S2E-7	96	5	6	19	126
6S2E-32	103	27	34	0	164
6S2E-36	90	40	0	0	130
6S3E-2	132	139	25	0	296
6S3E-6	52	29	10	0	81
6S3E-8	35	10	55	10	110
(Average)	92	36	19	4	151
(Sparrows Point district)					
Bal-Gf 10	157	41	42	0	240
Bal-Gf 11	144	42	43	0	229
Bal-Gf 12	129	99	67	0	295
Bal-Gf 53	167	115	15	2	299
Bal-Gf 78	103	142	6	0	251
Bal-Gf 139	148	86	21	16	271
Bal-Gf 161	65	105	7	5	182
Bal-Gf 171	56	161	10	0	217
(Average)	121	99	25	3	248

proximate, as the type of material cannot always be determined accurately even from drill cuttings, and the classification of the material probably is not the same for different drillers; nevertheless, the thickness reported for the sand and gravel probably is sufficiently accurate for a general evaluation of the water-bearing properties of the formation. The thickness of the sand and gravel has a wide range, but in general about half the formation consists of material classed by the drillers as sand and gravel. It is likely that most of this material is sufficiently permeable to be considered water-bearing.

The proportion of sand and gravel is less in the Harbor and Highlandtown districts, which are in or near the outcrop area, than in the other districts, which are farther down dip away from the outcrop.

Although not all of the wells in Table 4 completely penetrate the Patuxent formation, it is apparent that the total thickness of sand and gravel has a wide range in all the districts, thus reflecting the irregularity and discontinuity of individual beds. For example, in the Sparrows Point district the sand thickness for well Bal-Gf 171 is 56 feet in a total penetration of 217 feet, whereas well Bal-Gf 11, about 1.5 miles to the northwest, passed through 144 feet of sand in a total formation penetration of 229 feet.

Much of the clay encountered in wells penetrating the Patuxent formation is tough and "waxy" and requires more time for drilling than the sands or sandy clays; consequently, records of drilling time, which measure the rocks' toughness and resistance to abrasion, provide a means of comparing the lithologic character of the sediments. Figure 6 includes records of drilling time for two wells penetrating the Patuxent formation in the Fairfield and Dundalk districts. The character of the drilling-time curve for well 5S3E-46 in the Fairfield district indicates that the formation is composed chiefly of thin alternating layers of clay, sand, and sandy clay. In contrast the curve for well 3S5E-30 in the Dundalk district indicates that the Patuxent formation is composed of much thicker beds of sand with a relatively small amount of clay. With the possible exception of the relatively thick zone of clay near the bottom of each well, the two curves show that most of the individual beds are not continuous between the wells.

The sand and gravel in the Patuxent formation consists chiefly of subangular to subrounded grains of colorless to white quartz, although some grains are more highly colored. The sand is commonly arkosic and a large part of the material classed as sandy clay by the drillers is sand containing kaolin derived from the decomposition of feldspar. Nearly all the samples of drill cuttings contain particles of lignite, but this may not be significant because lignite has a relatively low specific gravity and circulates in the mud fluid during drilling, contaminating practically all the drill cuttings.

Hard layers of sandstone, cemented by iron oxide, are encountered in most of the wells penetrating the Patuxent formation. These layers are generally less than 2 feet thick. As they are difficult to drill through, they have been misjudged in a few places to be the crystalline rocks of pre-Cambrian age.

The heavy minerals in the sands of the Patuxent formation are sufficiently different from those in the Patapsco formation and Pleistocene deposits to permit distinction of the formations. Table 5 gives a tabulation of the heavy minerals in the sediments penetrated by well 3S5E-30 in the Dundalk district. The heavy-mineral suite is composed predominantly of zircon, tourmaline, and staurolite, with minor amounts of rutile, sillimanite, and kyanite. The most significant feature of the Patuxent formation is the relatively high content of staurolite.

In 1896, with the relatively few data available at that time, Darton (1896, pp. 142-148) divided the unconsolidated sediments, in the Baltimore industrial area, into three water-bearing zones, which he called A, B, and C. These zones, which are equivalent to most of the Patuxent formation, were considered to be at intervals of about 40 feet upward from the crystalline rock of pre-Cambrian age, and to be separated by sheets of clay and fine sand. A fourth zone, which Darton called D, is equivalent to a part of the Patapsco formation. A later report (Clark, Berry, and Mathews, 1918, pp. 338-350) used Darton's water-bearing zones in classifying most of the wells that had been drilled in the Baltimore area up to that time, although the zones were called Patuxent 1, 2, 3, and 4, thus apparently including sediments of Patapsco age with the Patuxent formation.

Several cross sections and an elaborate peg model, in which practically all the available logs of wells in the Baltimore area were represented, failed to show any part of the Patuxent formation as a continuous zone. The only possible exception is the zone of clay in the lower part of the formation in the Dundalk district and possibly the Fairfield district. This interval of clay appears to separate, at least locally, zones of water-bearing sand and gravel, but as the artesian head is the same for both zones it is not likely that the separation is continuous over a large area.

In some parts of the Sparrows Point district there appear to be two ill-defined water-bearing zones in the Patuxent formation, about 400 to 500 feet and 600 to 700 feet below the land surface, but the artesian head is identical for both zones and pumping tests show that water moves rather freely between them. Thus the geologic and hydrologic information indicates that the Patuxent formation in the Baltimore area functions as a single hydrologic unit and is not composed of separate widespread water-bearing zones. This, however, should not be construed to mean that the Patuxent formation cannot be divided into stratigraphic units. Detailed studies of heavy-mineral content, together with electrical logs, probably would afford adequate information for separating the formation into several units. However, the movement of ground water is governed by the laws of fluid mechanics and is not necessarily controlled by

TABLE 5

Estimated Percentage of Heavy Minerals in Coastal Plain Sediments in the Dundalk District, Baltimore

Source	Depth below land surface (feet)	Zircon	Tourmaline	Staurolite	Garnet	Rutile	Titanite	Brookite	Anatase	Hornblende	Actinolite	Hypersthene	Augite	Epidote	Clinozoisite	Andalusite	Sillimanite	Kyanite	Chloritoid	Chlorite	Biotite	Muscovite	Siderite	Geologic formation
Well 3S5E-30	16.8 - 18.8	1	1	30	Tr	1				35	10			1	15	Tr	2	2	2					Pleistocene
Federal Yeast	57 - 61	5	35	30	Tr											3	7	20						
Corp., Dundalk	106.7 - 116.7	50	40		5	1		1										1		Tr	1			
district	116.7 - 121.7	55	40		1	Tr													Tr		Tr			Patapsco
	126.7 - 131.7	55	40		1	Tr	Tr	Tr											Tr		Tr			
	142.2 - 147.2	70	27	Tr		Tr	Tr	1	Tr	Tr								Tr	1		Tr			
	236.6 - 241.6	20	40	35		Tr	Tr										1	3	Tr					
	242.6 - 246.6	10	15	44		5		1									5	20						
	255 - 257	32	20	30		2		Tr		Tr							Tr	15	Tr					
	267 - 269	60	15	10		10		Tr						Tr			1	4						
	279.7 - 285.7	40	15	30		5											5	5						
	297.7 - 298.2	40	30	10		10		2	Tr					Tr			2	6						
	310.2 - 312.2	10	24	40		10		1									5	10						
	322.8 - 326	9	15	30				1									20	25						Patuxent
	328.8 - 330.8	50	20	15		10			2								2	1						
	363 - 363.8	2	2	60		1											10	25				Tr		
	365.8 - 369.8	1	Tr	60		1											3	35						
	377.8 - 379.8	Tr	Tr	50		Tr				Tr							7	40			Tr	Tr		
	386.3 - 390.3	1	1	50		1		Tr									20	25	Tr					
	392.3 - 394.3	P[a]	P	P													P		(Poor separation)					

[a] P - Present.

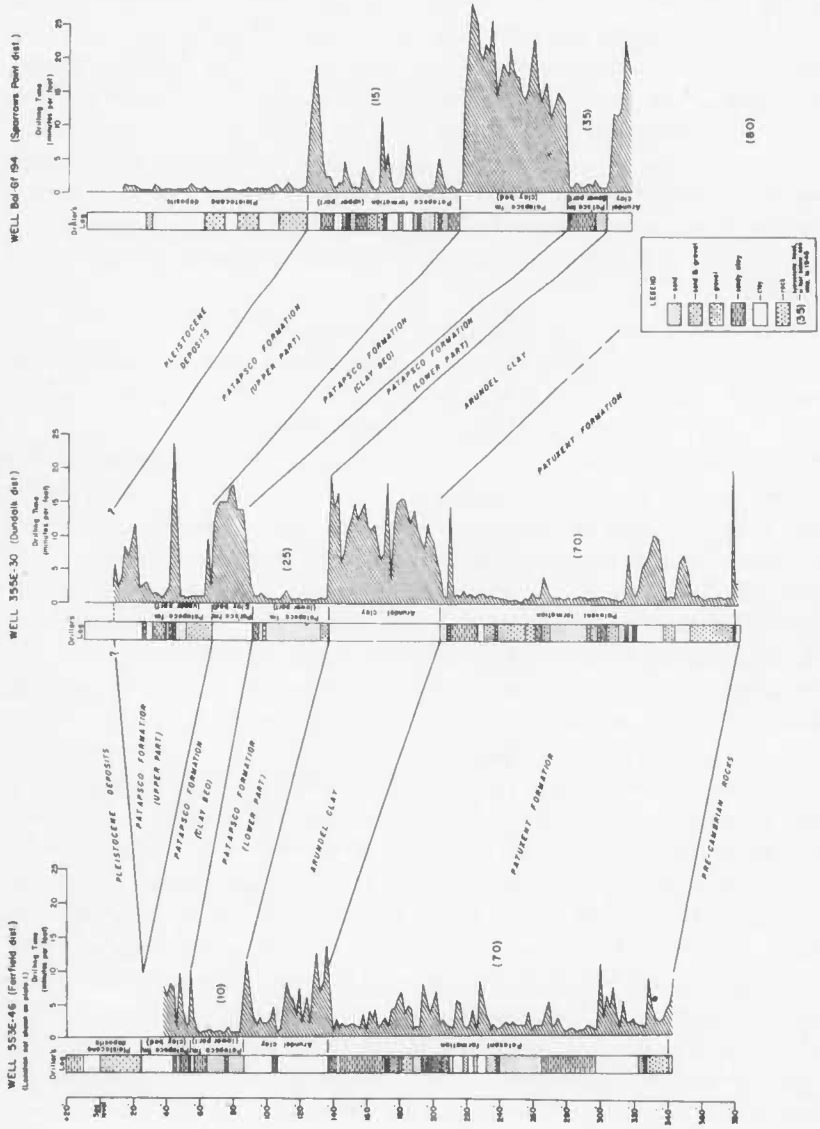


FIGURE 6. Correlation of geologic units between Fairfield, Dundalk, and Sparrows Point districts, Baltimore industrial area

stratigraphic units based, for example, on heavy mineral content, or on vertical differences in lithology of only local extent.

The thickness of the Patuxent formation cannot always be determined accurately from well logs. In some places the upper part of the formation contains clay similar to the overlying Arundel clay thus obscuring the contact between them. At some localities, where drill cuttings or drilling-time data were available, the top of the formation was readily determined (fig. 6). These determinations served as a guide for interpreting drillers' logs in which the top of the formation was not apparent. The thickness of the Patuxent formation in the subsurface ranges from about 150 to 300 feet and in most of the Baltimore area is about 200 feet (Pl. 6). The greatest thickness of the formation is in the Sparrows Point district where in some wells it is as much as 300 feet.

ORIGIN OF SEDIMENTS

Knowledge of the origin of the Patuxent sediments and the process by which they were deposited is helpful in making predictions as to the character and relative productivity of the formation in different areas.

Although a considerable amount of information on the character of the sediments of the Patuxent formation was obtained it is not adequate to explain fully the major sedimentational features. Furthermore, the structural movements of the crystalline rocks that led to increased erosion and to deposition of the sediments are not well understood. Aside from a general description of the manner of deposition of the sediments, an explanation of the areal differences in lithology is, therefore, largely speculative.

The moderately uniform plain of the crystalline-rock surface beneath the Coastal Plain, which has been called the Fall Zone peneplane (Sharp, 1929), has been considered coextensive with the Schooley peneplane in the Appalachian Mountain area (Davis, 1889, pp. 183-253), which in central Maryland is marked by the even crest lines and broad flat areas on some of the mountain tops at an altitude of 1,800 to 2,000 feet (Stose, 1946, p. 7). In the Baltimore area, however, the eastward slope of the Fall Zone peneplane is much steeper than the slope of the Schooley peneplane in the Appalachian area, indicating (1) that there have been structural movements, particularly an eastward tilting of the Fall Zone peneplane, or (2) that the two peneplanes were not formed at the same time and therefore are not related. Johnson (1931) and Shaw (1918, pp. 575-586) have presented evidence against considering the two peneplanes coextensive. Their conclusion is based chiefly on the marked difference in slope of the two peneplanes, and that the extensive uniform alignment of the Fall Line could best be explained by the intersection of two peneplanes rather than monoclinal flexing.

Stose (1940, pp. 461-476), however, has challenged this conclusion. He shows that in New Jersey the flat remnants of the Schooley peneplane form a gradual eastward descent to Tenmile Run Mountain where the gradient is about 50 feet to the mile. This gradient is about equal to the gradient of the bedrock floor beneath the Cretaceous sediments. Stose concluded, therefore, that the Fall Zone and Schooley peneplanes are the same.

In any event, it seems certain that, after the beginning of Cretaceous time, some structural movements of the crystalline rocks were necessary before these rocks could be extensively eroded and the resulting debris transported eastward. Those movements may have consisted essentially of an elevation of the rocks west of the present Fall Line, an eastward tilting of the rocks east of the present Fall Line, or perhaps a combination of both. The differential tilting caused the crystalline rocks, chiefly in the Piedmont Plateau, to be eroded and the debris to be transported to the depressed area east of the Fall Line.

The character of the sediments of the Patuxent formation provides the most significant information on the conditions under which the sediments were deposited. The arkosic sediments in the formation show that disintegration of the source rock was rapid and the resulting debris was transported quickly. Arkosic sediments of this type are commonly derived from granitic areas of steep and youthful topography (Krynine, 1941). The lenticular and irregular character of the sediments, the cross lamination of the sand and gravel deposits, the irregularly-shaped pieces of clay in the sand (clay galls), and the absence of marine fossils indicate that the Patuxent formation, at least within the Baltimore area, is continental. The exact manner in which the sediments were transported from the Piedmont area to the depressed area east of the Fall Line is not apparent, but it would seem logical that large coalescing alluvial fans were formed, fanning out to the east from the high crystalline-rock area west of the Fall Line. The alluvial fans probably merged eastward with sediments formed under a valley-flat environment characterized by numerous stream channels and associated flood plains containing lakes and swamps. Although a part of the Patuxent formation in or near its outcrop area may contain sediments deposited as alluvial fans, most of the Patuxent formation in the Baltimore area probably was deposited in the channels and flood plains of streams. It is characteristic of this environment that, in general, sand and gravel is deposited in the channels and silt and clay in the flood plains (Twenhofel, 1926, p. 569), but it is likely that the streams did not remain in fixed positions.

It would be most reasonable to assume that the streams flowed southeastward from the Piedmont highlands and that, owing to a gradual decrease in gradient, the sediments deposited from them would become finer-grained toward the southeast. If these conditions existed, the sediments in or near the present outcrop area of the formation should be coarser and more permeable than the sediments farther east, and the "trains" of coarse material or the "grain" of the formation would trend to the southeast, perpendicular to the

Fall Line. However, in the vicinity of Baltimore the quantity and permeability of the sand and gravel increase east of the outcrop area; and, if the sand and gravel deposits have any preferred direction, it is approximately parallel to the Fall Line. Of course, in relation to the areal extent of the entire formation the Baltimore area is only a very small "sample". In other areas the conditions may be different. Nevertheless, those conditions indicate the sedimentational history of the Patuxent formation is complex, and an analysis of the origin of the sediments that merely applies the general principles of geology and sedimentation would be over-simplified. The inhomogeneity and seemingly irregular sedimentational features of the formation should be kept in mind, as they affect the occurrence and movement of ground water.

WATER-BEARING PROPERTIES

The Patuxent is the most important water-bearing formation in the Baltimore area, but, in general, only a part of the formation is composed of material that is sufficiently coarse and permeable to be classed as water-bearing. The sand and gravel mixture that composes the water-bearing material is heterogeneous, consisting of a wide range of grade sizes and, in some beds, containing a large proportion of clay. Near the base of the formation the sediments appear to be very permeable, as they contain a large amount of pebbles and cobbles; but in many places these, together with grains of sand and gravel, have been cemented with clay, making the material practically impervious. Drill cuttings from wells show that much of the sand contains pieces of clay which through drilling are broken up and disseminated throughout the sand, making the sediments appear as a relatively impervious sandy clay; hence some of the material classed as sandy clay in the drillers' logs probably is permeable sand. Near the outcrop area much of the sand contains disseminated kaolin which imparts a milky color to the water pumped from some wells. With continued pumping the water usually becomes progressively clearer, but a few wells have been abandoned because the milky color persisted.

The most permeable water-bearing material is represented by the sand and gravel that is termed "free" by some drillers. This term is applied to the sand and gravel that is drilled easily and that caves or moves into the well during drilling.

The thickness of sand and gravel reported in drillers' logs (Table 4) shows a wide range, indicating, therefore, that the hydrologic properties of the formation are not uniform.

Yield of Wells

The yields of wells screened in the Patuxent formation provide a general index of the permeability of the water-bearing material, but it should be recognized that the yields also depend on the thickness of the water-bearing material screened, the efficiency of the well, and the drawdown. In the Baltimore area very few wells are screened in all the water-bearing material penetrated; therefore many of the wells yield much less than the maximum yield that could be developed.

The yields of large-diameter wells drilled in the Patuxent formation in the vicinity of Baltimore have a wide range but most are about 400 to 600 gallons a minute, although at one time a few wells had yields of as much as 1,000 gallons a minute. Industrial wells, ending in the Patuxent formation, in the Dundalk and Sparrows Point districts have the largest yields, generally amounting to 500 to 900 gallons a minute. The industrial wells in and near the outcrop area (Back River, Highlandtown, and Harbor districts) generally have yields of 200 to 300 gallons a minute, which is less than the average yields of industrial wells in any of the districts down the dip to the east.

The wells (Har-Ed 1 to 25) at the Army Chemical Center, about 15 miles northeast of Baltimore, have yields of less than 400 gallons a minute, even though some of the wells probably draw water from both the Patuxent and Patapsco formations. These relatively low yields indicate that in this part of the area the thickness and permeability of the water-bearing material in the Patuxent formation are less than in most of the districts in and near Baltimore.

The wells at the Aberdeen Proving Ground, in the northern part of the area near Aberdeen, have yields of as much as 645 gallons a minute (well Har-Df 9), but it is likely that a large part of the water from these wells is drawn from sediments of Pleistocene age.

Wells near the outer edge of the outcrop of the Patuxent formation, where the saturated thickness is relatively thin, have small yields. For example, the public-supply wells at Aberdeen (wells Har-Ce 1 to 9) have yields ranging from 11 to 40 gallons a minute; however, these wells are spaced closely and the yields were determined when several wells were pumping.

Few data are available on the water-bearing properties of the Patuxent formation in the southern part of the area, as nearly all the wells drilled to the formation in that area are used for domestic purposes, which require a relatively small supply of water. So far as is known the largest yield from a well in the Patuxent formation in this part of the area is from well AA-Bb 4 at the District Training School near Laurel, where a yield of 100 gallons a minute was obtained. The pump in that well, however, is set only 40 feet below the land surface, limiting the drawdown to a small amount; furthermore, the well is near the outcrop of the Patuxent formation where the thickness of the water-bearing material may be less than farther down the dip.

Specific Capacity of Wells

The specific capacity of a well, which is the yield per unit of drawdown and generally expressed in gallons a minute for each foot of drawdown, is a more accurate measure of a formation's capacity to yield water than is the yield of a well. The specific capacity takes into consideration the drawdown in the well, thus eliminating one variable that strongly governs the yield. However, the specific capacity is affected by the efficiency of the well, the thickness of water-bearing material screened, and to some extent by the duration of pumping during which the specific-capacity test is made. Consequently, the specific capacities reported in Table 6, many of which are based on reported static and pumping water levels measured several days apart and which generally represent wells screened in only a small part of the water-bearing material, should be considered only as a rough measure of the formation's capacity to yield water.

The specific capacities in Table 6 range from 1.3 to 19.6 gallons a minute per foot of drawdown and average 7.9. The average specific capacities reported for each district are: Highlandtown, 5.2; Canton, 8.5; Dundalk, 12.9; Fairfield, 7.3; Curtis Bay, 7.6; and Sparrows Point, 8.4. The specific capacity of a single well in the Back River district is 1.8. Except where a relatively large number of figures are available, as for the Fairfield and Sparrows Point districts, the average specific capacities may not be representative.

Permeability, Transmissibility, and Storage Coefficients

The properties of a water-bearing formation that determine its capacity to transmit water and to release water from storage are the coefficients of permeability, transmissibility, and storage. The coefficient of permeability, as defined by Meinzer (Stearns, 1928, p. 148), is the rate of flow of water, in gallons a day, through a cross-sectional area of 1 square foot, under a hydraulic gradient of 100 percent at a temperature of 60° F. This coefficient also may be expressed as the number of gallons of water, with a temperature of 60° F., that would flow through a strip of water-bearing material 1 mile wide and 1 foot thick, under a hydraulic gradient of 1 foot per mile. The unit of this coefficient of permeability is termed the *meinzer*. The field coefficient of permeability denotes the rate of flow under the prevailing temperature and other conditions in the aquifer being investigated.

The coefficient of transmissibility (Theis, 1935, p. 520) is the product of the field coefficient of permeability times the thickness of the saturated part of the aquifer. It may, therefore, be expressed as the quantity of water, in gallons a day, that flows through a strip of the aquifer 1 mile wide under a hydraulic gradient of 1 foot per mile.

The coefficient of storage is the quantity of water, in cubic feet, that is discharged from each vertical column of the aquifer with a basal area of 1 square foot for each foot of lowering in head.

These hydrologic properties of an aquifer, which may be determined by laboratory methods or by field methods, particularly by pumping tests on wells, define the water-bearing properties of an aquifer just as the thermal conductivity and specific heat define the properties of a metal in heat-transfer

TABLE 6

Specific Capacity of Some of the Industrial Wells Screened in the Patuxent Formation in the Baltimore Industrial Area

Well	Location	Yield (gal. a min.)	Specific Capacity
Bal-Fe 8	Back River district	200	1.8
1S3E-2	Highlandtown district	400	6.0
1S3E-3	do.	320	2.8
1S3E-4	do.	125	2.0
1S3E-7	do.	85	1.6
1S3E-19	do.	150	2.0
1S4E-1	do.	500	16.6
2S3E-64	Canton district	504	7.4
3S2E-1	do.	60	15.0
2S4E-1	do.	240	3.1
2S5E-1	Dundalk district	260	12.4
3S4E-1	do.	450	19.6
3S5E-31	do.	750	6.8
4S2E-2	Fairfield district	90	18.0
5S2E-2	do.	214	5.5
5S2E-20	do.	310	9.7
5S3E-2	do.	595	8.4
5S3E-4	do.	70	5.0
5S3E-6	do.	52	3.5
5S3E-12	do.	500	6.3
5S3E-13	do.	83	7.3
5S3E-14	do.	82	9.0
5S3E-21	do.	193	9.0
5S3E-33	do.	375	2.6
5S3E-34	do.	275	3.8
5S3E-37	do.	390	3.7
5S3E-38	do.	860	10.2
6S2E-4	Curtis Bay district	410	3.9
6S2E-9	do.	650	9.0
6S2E-31	do.	60	4.6
6S3E-8	do.	500	19.2
AA-Ad 8	do.	100	1.3
Bal-Gf 3	Sparrows Point district	460	8.0
Bal-Gf 5	do.	550	8.8
Bal-Gf 8	do.	620	12.4
Bal-Gf 9	do.	510	8.0
Bal-Gf 11	do.	690	7.2
Bal-Gf 12	do.	410	10.5
Bal-Gf 16	do.	520	7.7
Bal-Gf 32	do.	620	14.4
Bal-Gf 52	do.	605	12.6
Bal-Gf 74	do.	235	3.2
Bal-Gf 105	do.	540	11.5
Bal-Gf 139	do.	550	9.6
Bal-Gf 199	do.	364	5.9

problems, or as resistivity and capacitance define the properties or characteristics of some electrical circuits.

During the period of field work for this report, only a few new wells were drilled into the Patuxent formation in the vicinity of Baltimore, so that only a small number of samples of water-bearing material were collected for determination of permeability. Cuttings from only a few wells drilled prior to the investigation were available. Table 7 gives the coefficients of permeability of several samples from three wells in Baltimore, determined with a U. S. Geological Survey variable-head permeameter (Wenzel, 1942, pp. 59-62).

As the sediments in the Patuxent formation are largely unconsolidated, the arrangement of the grains in samples obtained in drilling is not the same as it is under natural conditions. That factor as well as several others prevent a reasonably accurate determination of the permeability of the formation by laboratory methods. Nevertheless, in relation to each other the permeability figures given in Table 6 probably are reasonably correct; they are useful, therefore, in showing the degree of inhomogeneity of the water-bearing material in the formation.

There are several mathematical formulas, based on the behavior of the water table or piezometric surface around a pumped well, that can be used to determine the coefficients of transmissibility and storage. Those formulas are of two basic types, equilibrium and nonequilibrium, but Wenzel (1942, pp. 90-91) has demonstrated that when the time of discharge is large the two types of formulas are essentially equal. The basic equilibrium formula is known as the Thiem formula (Wenzel, 1936, p. 81), which for artesian conditions is

$$T = \frac{527.7q \ \log \frac{r_2}{r_1}}{s_1 - s_2}$$

where T is the coefficient of transmissibility; q is the rate of pumping in gallons a minute; r_1 and r_2 are the distances, in feet, of two observation wells from the pumped well; and s_1 and s_2 are the respective drawdowns, in feet, of the water levels in the two observation wells.

The basic nonequilibrium formula, developed in 1935 under the direction of Theis, is

$$s = \frac{114.6q}{T} \int_{\frac{1.87r^2S}{Tt}}^{\infty} \frac{e^{-u}}{u} du$$

where s is the drawdown or recovery, in feet, at any point within the cone of influence, q is the discharge of the pumped well in gallons a minute, T

TABLE 7

Coefficient of Permeability of Drill-Cutting Samples of Water-Bearing Material in the Patuxent Formation

Well	Depth interval below land surface (feet)	Coefficient of permeability (gal./day/ft.^{2} at 60°F.)
5S2E-2 (Fairfield district)	199-203	575
	203-205	2,500
	205-209½	2,050
	209½-211½	1,500
	211½-215½	3,200
	215½-219½	1,600
	219½-221½	1,950
	238-250	275
	321-323	13,000
	323-325	15,000
	327-331	150
3S5E-30 (Dundalk district)	190-195	2,200
	195-199	4,100
	247-248	675
	248-252	2,600
	253-255	2,150
	255-257	3,050
	259-261	4,850
	261-265	280
	289-293	250
	350-355	3,600
	382-386	5,100
1S4E-19 (Highlandtown district)	178-183	550
	183-188	1,100
	200-201	600
	219-237	800

is the coefficient of transmissibility, S is the coefficient of storage, r is the distance in feet of the observation point from the pumped well, and t is the time in days since pumping was started or stopped.

There are some variations (Fishel, 1946; Cooper and Jacob, 1946, pp. 526-534) of the two preceding formulas that simplify the computations.

All the formulas are based on ideal conditions that are seldom, if ever, realized in nature. They assume that the aquifer is infinite in areal extent, that it is homogeneous and isotropic (transmits water equally in all directions), that it is bounded at the top and bottom by impermeable material, that it has a uniform thickness, and that water is released instantaneously from storage with a decline in head. They further assume that the discharging well is of infinitesimal diameter, completely penetrates the aquifer, and the flow of the water toward the well is radial or two dimensional.

The principal data used in determining the coefficient of transmissibility by the Thiem formula are the differences in drawdown or recovery in two observation wells, after the cone of depression has reached equilibrium, at least as far out as the most distant observation well, caused by pumping or shutting down one or more wells or by changing the rate of pumping. The Theis nonequilibrium formula, which can be used to determine both the coefficients of transmissibility and storage, may be applied to the drawdown or recovery in a single observation well or to the drawdown or recovery in two or more observation wells. For determining the coefficient of transmissibility the nonequilibrium formula also may be applied to the rate of recovery or drawdown in the pumped well or any observation well. All of these methods were used in pumping tests in the Baltimore area and most sets of pumping-test data were analyzed by means of several formulas. An example of the application of two nonequilibrium formulas (which, of course, have the same basis and differ only superficially) is given in Figure 7. The formula given under A is a variation of the Theis nonequilibrium formula devised by Cooper and Jacob (1946, pp. 526-534) and the formula given under B is the Theis recovery formula (Theis, 1935, pp. 519-524).

In this example well Bal-Gf 5 (Sparrows Point district), after being pumped at a rate of 370 gallons a minute (0.825 cubic feet a second) for several weeks, was shut down and the recovery of the water level in Bal-Gf 6, which is 140 feet from well Bal-Gf 5, was measured during a period of 108 minutes. The plotted values of the recovery in well Bal-Gf 6 form essentially a straight line on a semilogarithmic graph, which is in accord with the theory upon which the formula is based.

A summary of the results of the pumping tests of wells ending in the Patuxent formation is given in Table 8. Most of the tests have been analyzed by more than one formula in order to average out the human-element error that is inherent in the construction or matching of curves.

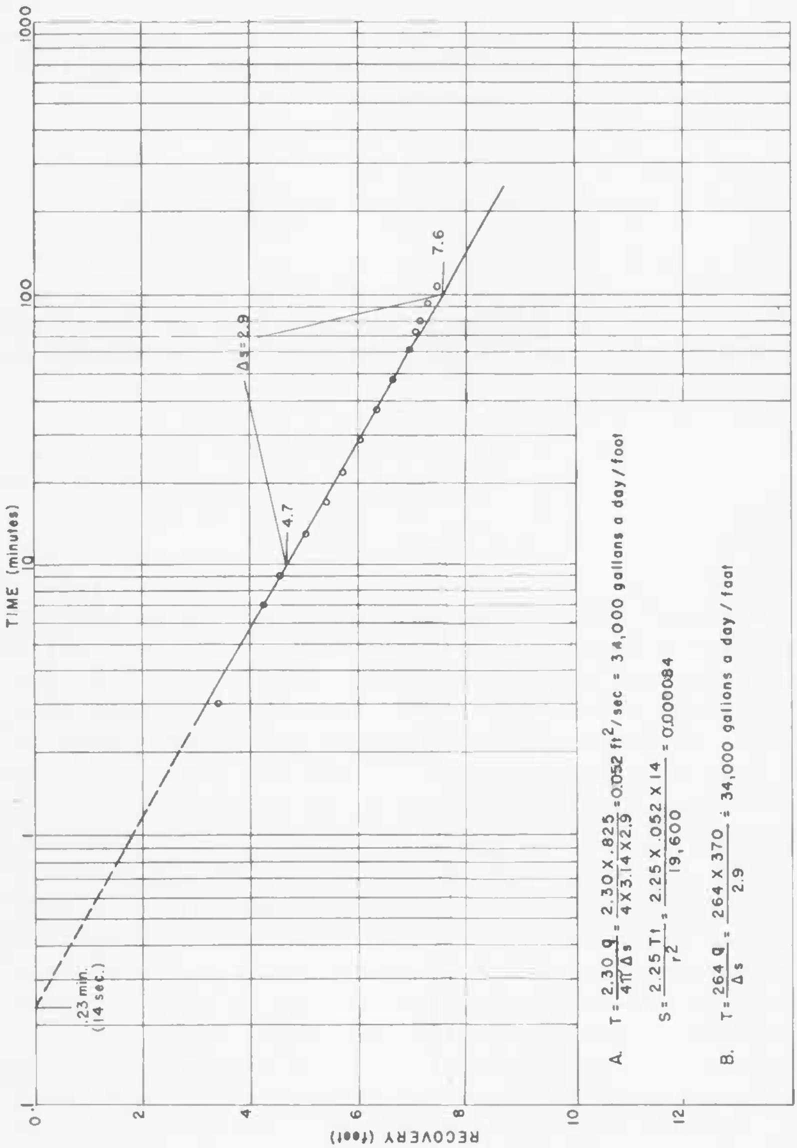


FIGURE 7. Graph showing methods of determining coefficients of transmissibility and storage from pumping tests on wells Bal-Gf 5 and 6

The computed values of transmissibility and storage have a wide range; however, this inconsistency may be explained in part by the poor data obtained in some of the pumping tests. An attempt was made to evaluate the accuracy of the tests, chiefly by judging the alinement of the plotted drawdown or recovery curves against their theoretical alinement. The evaluations of the accuracy of the tests range from poor to excellent; they are shown in the last column of Table 8.

Most of the pumping tests were run on wells in the Sparrows Point district where reasonably good control of the pumping of wells could be maintained, thus preventing any extraneous influence on the drawdown or recovery of the water level in the observation wells. Using only the coefficients of transmissibility and storage obtained from tests in this district that were rated good or excellent, the average coefficient of transmissibility is 50,000 gallons a day per foot and the average coefficient of storage is 0.00026; and the range in transmissibility and storage is from 28,500 to 75,600 and 0.000011 to 0.00080, respectively.

Although most of the pumping tests in the Dundalk district are rated as good, it is likely that the computed values are not representative of the entire aquifer, as none of the wells used in these tests are screened in the lower part of the aquifer, which is separated locally from the overlying water-bearing material.

The wide range in coefficients obtained from the pumping tests in the Sparrows Point district probably is due in part to the inhomogeneity of the aquifer; however, it also may be caused partly by the wide departure from radial flow assumed in derivation of the formulas. In some of the tests the pumped well and the observation wells were screened in only a small part of the aquifer; hence, water moving toward the pumped well had a vertical component. This may cause a large error in the drawdown or recovery in the observation well; consequently, some of the computed coefficients of transmissibility and storage may be in error. Under ideal conditions, water will flow radially toward a partially penetrating pumped well beyond a distance of about twice the thickness of the aquifer (Muskat, 1937, p. 271). However, if the permeability is larger in a horizontal than in a vertical direction, as it is in most formations having stratification, then the zone of nonradial flow would extend a greater distance outward from the pumped well. Unfortunately, most of the pumping tests in the Baltimore area necessarily utilized observation wells within a few hundred feet of the pumped well; consequently the error introduced by the vertical component of flow probably is large. Jacob (1945) recently devised a method for correcting the drawdown and recovery affected by nonradial flow; however, in general his method is practical only when applied to aquifers that have a reasonably uniform thickness and in which the observation wells are screened at either the top or the

TABLE 8

Summary of Permeability, Transmissibility, and Storage Coefficients Determined by Pumping Tests in the Patuxent Formation

Wells (pumped well is underscored)	Location	Pumping-test method	Duration (min.)	Screen length in pumped well (feet)	Effective sand thickness (feet)	Formula used for analysis[a]	Coefficient of transmissibility (gal./day/ft.)	Coefficient of storage (cu.ft./ft.)	Field coeff. of permeability (gal./day/ft.^{2})	Estimate of accuracy of test[b]
1S3E-4	Highlandtown district	Recovery in pumped well	69	20	45	D	6,200	-	140	F
3S4E-2	Dundalk district	do	132	45	60	D	10,600	-	180	F
3S4E-2 3S5E-11	do	Recovery interference	132	45	60	B	29,700	0.00019	500	G
Do	do	do	132	45	60	C	19,700	.000185	330	G
Do	do	Drawdown interference	132	45	60	B	29,700	.00019	500	G
Do	do	do	132	45	60	C	23,000	.00017	380	G
Bal-Gf 11	Sparrows Point district	Recovery	53	50	50	D	21,500	-	430	P
Bal-Gf 11 and 6	do	Drawdown interference	73	50	50	B	66,600	.000011	1,330	E
Do	do	do	73	50	50	C	48,500	.000069	970	G
Do	do	do	73	50	50	D	67,300	-	1,350	E
Do	do	Recovery interference	70	50	50	B	56,200	.000053	1,125	G
Do	do	do	70	50	50	C	60,000	.000014	1,200	F
Do	do	do	70	50	50	D	56,200	-	1,125	G
Bal-Gf 5 and 6	do	do	120	30	50	B	38,900	.00062	780	E
Do	do	do	120	30	50	C	42,100	.000042	840	E
Do	do	do	120	30	50	D	38,800	-	775	E
Do	do	do	108	30	50	B	33,600	.000084	670	E
Do	do	do	108	30	50	C	34,200	.000081	685	E
Do	do	do	108	30	50	D	33,700	-	675	E
Bal-Gf 3	do	Recovery in pumped well	76	26	50	D	32,100	-	640	G
Bal-Gf 3 and 6	do	Drawdown interference	150	26	50	B	32,300	.000042	645	E
Do	do	do	150	26	50	C	32,100	.000038	640	E
Do	do	Recovery interference	76	26	50	C	28,500	.000052	570	E

TABLE 8—*Continued*

Wells (pumped well is underscored)	Location	Pumping-test method	Duration (min.)	Screen length in pumped well (feet)	Effective sand thickness (feet)	Formula used for analysis[a]	Coefficient of transmissibility (gal./day/ft.)	Coefficient of storage (cu.ft./ft.)	Field coeff. of permeability (gal./day/ft.^{2})	Estimate of accuracy of test[b]
Bal-Gf <u>3</u> and 6	Sparrows Point district	Recovery interference	76	26	50	D	34,200	-	680	E
Do	do	Drawdown interference	150	26	50	D	31,300	-	630	E
Bal-Gf <u>3</u>, <u>5</u>, <u>11</u>, <u>16</u>, and <u>53</u>	do	do	296	50	80	A	139,000 to 183,000	-	-	P
Do	do	do	296	50	80	B	141,000 to 185,000	.00012 to .000061	-	P
Bal-Gf <u>3</u>, <u>5</u>, <u>11</u>, and <u>53</u>	do	do	296	50	80	C	65,500	.00075	820	E
Do	do	do	296	50	80	B	114,500	.000062	1,430	P
Do	do	do	296	50	80	D	113,400	-	1,420	P
Do	do	Recovery interference	170	50	80	D	70,000	-	875	F
Do	do	do	170	50	80	C	74,400	.0008	930	E
Bal-Gf <u>3</u>, <u>5</u>, <u>11</u>, and <u>16</u>	do	Drawdown interference	296	50	80	B	91,600	.000057	1,145	P
Do	do	do	296	50	80	C	65,200	.00078	815	E
Do	do	do	296	50	80	D	90,700	-	1,130	P
Do	do	Recovery interference	170	50	80	C	75,600	.00067	945	E
Do	do	do	170	50	80	D	67,700	-	845	F

[a] *A. Thiem equilibrium formula as applied by Fishel (1946).*
B. Cooper and Jacob (1946, pp. 526-534) graphical method.
C. Theis (1935, pp. 519-524) nonequilibrium formula.
D. Theis (1935, pp. 519-524) nonequilibrium (recovery) formula.

[b] *E - excellent*
G - good
F - fair
P - poor

bottom of the aquifer. In any event, it seems likely that the water-bearing material in the Patuxent formation is so irregular that any attempt to correct for partial penetration would be futile.

The irregular character of the sediments, together with the necessity of using partially penetrating wells that are closely spaced, leads to the conclusion that most of the computed values of transmissibility given in Table 8 should be considered correct only to a general order of magnitude. The coefficients of transmissibility determined from some of the tests in the Sparrows Point district, however, may be reasonably accurate, but the computed value of transmissibility of the formation in this district, which averaged about 50,000, is not necessarily representative of the transmissibility in other parts of the Baltimore area.

The accuracy of computed coefficients of storage also is limited by the errors inherent in the pumping-test methods under poor conditions. The average coefficient of storage of 0.00026, determined in the Sparrows Point district where considerable geologic and hydrologic information is available, is believed to be reasonably correct and probably is fairly representative of the Patuxent formation throughout the area. If this figure is converted to a unit basis by dividing it by the estimated effective sand thickness the storage coefficient becomes 3.2×10^{-6} per foot of thickness of the aquifer. This figure is in general agreement with several reported coefficients of storage, converted on a similar basis, obtained from pumping tests in unconsolidated water-bearing material in artesian aquifers chiefly in the Gulf Coastal Plain; however, such a close agreement may be largely fortuitous.

The coefficient of storage of 0.00026 applies only to the Patuxent formation where the water occurs under artesian conditions. Under artesian conditions the material remains saturated and the small amount of water represented by the coefficient of storage is derived by compaction of the aquifer and associated fine-grained beds and by expansion of the water itself, as the water level declines. In the outcrop area where the water generally occurs under water-table conditions the coefficient of storage (specific yield) is considerably higher. There a large proportion of the water is drained from the water-bearing material when the water table is lowered. Owing to the difficulty of controlling extraneous pumping, no tests were made to determine the specific yield in the outcrop area. However, in water-bearing material similar to that in the Patuxent formation it is typically about 0.15 to 0.20.

Thus the coefficient of storage in those parts of the formation where the water-bearing material is dewatered by a decline in the water table (chiefly the outcrop area) is approximately 1,000 times larger than the coefficient of storage in the artesian area.

The transmissibilities determined by pumping-test methods represent only small "samples" and therefore may not be representative evaluations of the transmissibility of the Patuxent formation over a large area. Thus in order to determine the average coefficient of transmissibility in the different parts of the Baltimore industrial area, the configuration of the piezometric surface surrounding the localities of heavy pumpage was analyzed by construction of a flow net[3] (Pl. 7). On this flow net the dashed lines are flow lines which under ideal conditions mark the path that a particle of water would follow to the point of discharge. The solid lines that cross the flow lines are called equipotential lines and represent the contours connecting points of equal altitude, in feet below sea level, of the artesian head. Under ideal conditions, where the water-bearing material is homogeneous and isotropic, the flow lines cross the equipotential lines at right angles, as that is the direction of maximum gradient.

The flow net shown on Plate 7 was constructed so that, where possible, the intersecting equipotential and flow lines formed "squares"; that is, in a single "square" or flow field, the distance between the equipotential lines is equal to the distance between the flow lines. This method of constructing flow nets is known as the Forchheimer graphical solution (Casagrande, 1937, pp. 135-137).

If the permeability and transmissibility of the water-bearing material were uniform the same quantity of water would flow between any two flow lines and the quantity of water flowing into a discharge point, for example a well or group of wells, would be determined by the number of flow paths. This relationship may be expressed by the following equation:

$$q = \frac{nf}{nd} Th$$

where

q = quantity of water, in gallons a day
nf = number of flow paths
nd = number of equipotential drops
T = coefficient of transmissibility, in gallons a day per foot
h = total decrease in head, in feet

Flow nets are constructed more readily for problems in which the coefficient of transmissibility is uniform than where it is not, for differences in transmissibility cause the flow lines and equipotential lines to change direction at the boundary between the two areas of different transmissibility. This change in direction or refraction follows the tangent law (Hubbert, 1940, pp. 844-847). Furthermore, after passing into a medium of higher or lower trans-

[3]For discussion of flow-net analysis see Taylor, Donald W., Soil mechanics, pp. 156-204, John Wiley & Sons, Inc., 1948.

missibility, the intersecting flow and equipotential lines change from "squares" to "rectangles." The ratio of the lengths of the sides of the "rectangles" is equal to the ratio of the two transmissibilities.

In the Baltimore area the transmissibility of the Patuxent formation is not uniform; consequently, the flow net on Plate 7 ideally should be composed of "rectangles" with different lengths and widths. However, the chief purpose of a flow-net analysis of the Baltimore area was to determine the coefficients of transmissibility rather than the quantity of water discharged from wells. That quantity was determined more accurately by means of measurements and estimates of pumpage. The quantity of discharge being known, the approximate coefficients of transmissibility were determined from the flow net constructed by means of the Forchheimer graphical solution. The control for the equipotential lines was obtained by the measurements of the altitude of the water levels in observation wells. The net was then drawn by trial and error so that the equipotential lines fitted most of the observed water-level measurements but at the same time formed a system of "squares," wherever possible, with the intersecting flow lines. Although the net could be improved further, a perfect system of "squares" that would fit all the observed water-level data probably could not be constructed. Further improvement of the net would not change appreciably the computed coefficients of transmissibility.

By this method of construction the density of flow paths into the localities of discharge is controlled by both the quantity of discharge and the transmissibility; as the quantity of discharge is known, the transmissibility can be determined from the equation

$$T = \frac{q}{\frac{nf}{nd} h}$$

For example, in 1945 the average discharge from the Patuxent formation in the Sparrows Point district was 7,500,000 gallons a day. The flow net shows 15 flow paths surrounding this district, hence nf equals 15. Using the number of equipotential drops between the 30- and 60-foot contours, nd is equal to 3. The total head loss or potential drop between the 30- and 60-foot contours is 30 feet, therefore h is equal to 30 feet.

The equation is thus:

$$T = \frac{7{,}500{,}000 \text{ (gallons a day)}}{\frac{15 \text{ (flow paths)}}{3 \text{ (potential drops)}} \times 30 \text{ (total head loss)}}$$

TABLE 9

Approximate Coefficients of Transmissibility in the Baltimore Industrial Area, Determined by Flow-net Analysis

District	Quantity of pumpage (gal. a day) (Q)	Number of flow paths (nf)	Number of equipotential drops (nd)	Total head loss, feet (h)	Approximate coefficient of transmissibility (gal./day/foot)
A. Sparrows Point	7,500,000	15	3	30	50,000
B. Curtis Bay - Fairfield	8,500,000	26	1	10	35,000
C. Dundalk - Canton	5,600,000	8	1	10	70,000
D. Harbor	2,100,000	10	1(-)	10(-)	21,000
E. Highlandtown	2,800,000	13	1	10	21,500
F. Back River	2,000,000	12	2	20	16,500

$$\text{or } T = \frac{7{,}500{,}000}{15 \times 10} = 50{,}000 \text{ (gallons a day/foot).}$$

The coefficients of transmissibility determined by this method for the districts in the Baltimore area are given in Table 9.

As the application of this method of analysis in the Baltimore area has many limitations, the coefficients of transmissibility in Table 9 should be considered approximate. The transmissibility may change abruptly between different parts of the area but the flow net assumes a gradual change. An abrupt change increases the number of flow paths around the area of higher transmissibility and decreases the flow paths around the area of lower transmissibility, and accordingly causes the computed lower transmissibility to be too high and the computed higher transmissibility to be too low. This method of determining the transmissibility, however, includes large parts of the aquifer, thus eliminating or decreasing appreciably the effect of local irregularities, and furthermore avoids the error inherent in pumping-test methods where the pumped well is screened in a small part of an aquifer as irregularly bedded as the Patuxent formation. It is reasonable, therefore, to conclude that the coefficients of transmissibility computed from the flow net are more representative and accurate for the area as a whole than the coefficients determined by the pumping-test methods.

The coefficients of transmissibility determined by the flow-net analysis range from 16,500 in the Back River district to 70,000 in the Dundalk and Canton districts. The transmissibility in the districts in or near the outcrop of the Patuxent formation is less than the transmissibility in the districts down the dip southeast of the outcrop area. The average of the coefficients of transmissibility in the Back River, Highlandtown, and Harbor districts, which are in or near the outcrop area, is about 19,500. This figure contrasts markedly with the average coefficient of transmissibility of about 51,500 in the Dundalk-Canton, Sparrows Point, and Curtis Bay-Fairfield districts, which are down the dip southeast of the outcrop. This difference in transmissibility may be explained in part by the difference in sand thickness in the Patuxent formation between the districts in or near the outcrop area and those down the dip to the southeast. Thus, in the Harbor and Highlandtown districts the average sand thickness is about 50 feet, whereas the average sand thickness in the Dundalk-Canton, Curtis Bay-Fairfield, and Sparrows Point districts is about 90 feet (Table 4). The higher transmissibility of the formation in the districts down the dip also is reflected in the yields of wells. Wells in those districts generally yield about 500 to 900 gallons a minute, whereas wells in the districts in or near the outcrop area yield about 200 to 300 gallons a minute. The average specific capacity of wells reported in Table 6 also shows the areal differences in transmissibility. The highest average specific capacity, 12.9, is in the Dundalk district, which according to the flow-net analysis also has the highest transmissibility; the lowest specific capacities, 1.8 and 5.2, are respectively in the Back River and Highlandtown districts, which according to the flow-net analysis have low transmissibilities.

Further support for the accuracy of the transmissibilities determined by the flow-net analysis is given by the average coefficient of 49,700 obtained from several pumping tests in the Sparrows Point district. This figure is nearly the same as the coefficient of transmissibility of 50,000 determined by the flow-net analysis for this district; but such close agreement is probably accidental. Nevertheless, practically all the data on the water-bearing properties of the Patuxent formation, including yields of wells, thickness of water-bearing material, specific capacities, and pumping tests, are in harmony with the transmissibilities obtained by the flow-net analysis.

UPPER CRETACEOUS SERIES

ARUNDEL CLAY

DISTRIBUTION AND CHARACTER

The Arundel clay (formerly known as the Arundel formation) was named by Clark and Bibbins (1897, p. 485) for its exposure in Anne Arundel County, where it was first recognized as a stratigraphic unit. The formation crops out as an irregular belt, from about half a mile to 3 miles wide (Pl. 2), extending northeastward across the area to the vicinity of Bush River (Maryland Geol. Survey, 1933), about 20 miles northeast of Baltimore, where it either pinches out or changes in lithology so that it is not recognizable as a stratigraphic unit. The continuity of the outcrop is broken by Gunpowder Falls and the Patapsco and Back Rivers, and, in a few places, by overlapping sediments of Pleistocene age. The formation is not well exposed except where it is excavated for the production of clay.

On the outcrop the Arundel clay is composed chiefly of gray and red clay containing irregularly shaped hard layers and masses of sandstone cemented by iron oxide, and geodes and nodules of limonitic material. Much of the clay is practically free of sand, although in some places it contains lenses of sand and sandy clay. The formation contains particles of lignite, and, in some localities, plant fragments, including trunks, limbs, twigs, and leaves (Clark, Bibbins, and Berry, 1911, p. 65). The sediments are of continental origin and presumably were deposited in swamps.

In the part of the Baltimore industrial area southeast of the outcrop, the Arundel clay is penetrated by many wells that end in the underlying Patuxent formation. According to drillers' logs the Arundel clay consists predominantly of hard or tough red, blue, and brown clay with thin layers of indurated rock. In general the top of the formation can be determined from the description of the sediments in the logs, but, owing to the similarity of lithology in the upper part of the Patuxent formation, the bottom of the Arundel clay is obscure in most drillers' logs. If drilling time and drill cuttings are available, the top and bottom of the Arundel clay may be determined accurately. Figure 6 shows the drilling time and lithologic logs of the three wells in the vicinity of Baltimore. The drilling time required in the Arundel clay is relatively great and because of this the formation is an excellent reference datum. Although the well drillers commonly refer to the clay as being "hard", owing to the difficulty of drilling in it, actually the clay is rather soft and plastic. It is resistant to abrasion chiefly because of its "greasy" or unctuous character.

In the vicinity of Baltimore the thickness of the formation ranges from about 25 to 200 feet and in general the formation is thinnest near the outcrop (Pl. 6). The average or typical thickness, in the vicinity of Baltimore, is about 75 to 100 feet.

WATER-BEARING PROPERTIES

The Arundel clay is not considered to be a water-bearing formation. The few sand lenses in the formation contain water, but as these lenses are of only local extent wells ending in them probably would have small yields. No wells in the Baltimore area are known to draw water from the Arundel clay.

CONFIGURATION OF SURFACE OF ARUNDEL CLAY

Plate 8 shows, by means of contours, the altitude of the top of the Arundel clay in the Baltimore industrial area. This structural-contour map shows that the formation has a moderately uniform dip of about 40 feet to the mile toward the southeast. In the area northeast of Baltimore the strike of the formation is northeast, but in the area southwest of Baltimore the strike gradually changes to a more northerly direction. Some of the irregularity in the configuration of the surface of the Arundel clay, indicated by the contours, is due to erosion preceding the deposition of the sediments of the overlying Patapsco formation. The shape of the contours in the Dundalk and Sparrows Point districts suggests that a northwest-trending erosional depression is present in the Arundel clay in these districts. Other erosional irregularities probably would be apparent if additional well data were available.

PATAPSCO FORMATION

DISTRIBUTION AND CHARACTER

The Patapsco formation, which unconformably overlies the Arundel clay, was named for its exposure in the vicinity of the Patapsco River (Clark and Bibbins, 1897, p. 489). It crops out in a relatively broad belt (Pl. 2) extending northeast across the area; some parts of the outcrop area, however, are covered by sediments of Pleistocene age and in these parts the width of the outcrop is relatively small. The outcrop is crossed by some of the estuaries—for example, the Patapsco River; in those places the formation is directly exposed to brackish water. The land surface on the formation is gently rolling to flat and good exposures are rare; however, in some localities where sand and gravel is mined, the formation is well exposed (Pl. 23 A).

The sediments in the Patapsco formation are of continental origin and were derived from the same type of crystalline rocks as were the sediments of the Patuxent formation. Hence the Patapsco formation is lithologically similar to the Patuxent formation, consisting chiefly of unconsolidated sand, gravel, and clay in beds that are commonly lenticular or irregular. A large part of the sediments contains disseminated kaolin derived from the decomposition of feldspar grains; and some of the sand beds contain irregularly-shaped pieces of clay. Cross-bedding is common, and the texture of the sediments changes markedly within short distances. Thin layers or lenses of sandstone, cemented by iron oxide to form hard rock, are present in places but are not as common as in the Patuxent formation. Some parts of the formation contain small fragments of lignitic material, similar to that in the Patuxent formation. In general the sand and gravel beds are light gray to buff, and the clay and sandy clay are white, gray, or red; some clay beds, however, are mottled red and white.

The Patapsco formation is relatively unfossiliferous, but at some localities specimens of plant remains have been collected.

Although examination of outcrops of the Patapsco formation provided general information on its lithologic character, much more detailed data were obtained from drillers' logs and drill cuttings. The subsurface data show that the formation is composed essentially of sand and gravel, clay, and sandy clay in varying proportions. Table 10 gives the thickness of different types of sediments encountered in wells penetrating the Patapsco formation in the Baltimore industrial area. The sand and gravel, which is the water-bearing material, has a wide range in thickness, ranging from about 20 to 80 percent of the thickness of the formation. The thickness of sand and gravel is greatest in the Sparrows Point district where it averages about 95 feet.

The heavy minerals in the Patapsco formation are sufficiently diagnostic to distinguish it from the overlying Pleistocene sediments and from the Patuxent formation. Table 11 gives a record of the heavy minerals contained in drill-cutting samples from well Bal-Gf 194 (Sparrows Point district) and in outcrop samples in the Curtis Bay district. The heavy-mineral suite of the Patapsco formation contrasts with the Pleistocene by its large amount of zircon and tourmaline and by the small amount of garnet and hornblende. It contrasts with the mineral suite in the Patuxent formation by its low content of staurolite. (See also Table 5.) Except for the sample from 303-311 feet, the samples of drill cuttings from the Patapsco formation listed in Table 11 contain similar proportions of heavy minerals. The heavy minerals in the sample

TABLE 10

Thickness, in Feet, of Different Types of Sediments Encountered in Wells Penetrating the Patapsco Formation in the Baltimore Industrial Area

(Data obtained from drillers' logs)

Well	Sand and/or gravel	Clay and/or hard rock	Sandy clay	Sand and clay	Thickness of formation penetrated (feet)
(Dundalk district)					
3S4E-2	18	61	11	-	90
3S5E-30	61	53	12	-	126
(Average)	40	57	11	-	108
(Curtis Bay and Fairfield districts)					
5S2E-30	13	10	7	-	30
5S3E-2	23	6	11	-	40
5S3E-17	57	18	7	7	89
5S3E-46	22	23	16½	-	61½
6S2E-1	29½	14	17	-	60½
6S2E-3	21	24	10	-	53
6S2E-5	19	34	22	-	75
6S3E-2	17	25	19	-	61
(Average)	25	19	14	1	59
(Sparrows Point district)					
Bal-Gf 5	90½	43½	19	17	170
Bal-Gf 10	61	88	39	-	188
Bal-Gf 12	113	127	6	-	246
Bal-Gf 45	59	92	-	-	151
Bal-Gf 74	88	76	18	-	182
Bal-Gf 78	80½	80½	-	-	161
Bal-Gf 109	19	94	4	-	117
Bal-Gf 111	36	81	33	-	150
Bal-Gf 114	53	84	24	-	161
Bal-Gf 134	173	55	12	-	240
Bal-Gf 161	105	42	38	-	185
Bal-Gf 162	95½	48½	8	26	178
Bal-Gf 171	188	21	-	-	209
Bal-Gf 174	159	23	-	-	182
(Average)	96	65	14	3	178

TABLE 11

Estimated Percentage of Heavy Minerals in Coastal Plain Sediments in Sparrows Point and Curtis Bay districts

Source	Depth below land surface (feet)	Zircon	Tourmaline	Staurolite	Garnet	Rutile	Titanite	Brookite	Anatase	Hornblende	Actinolite	Hypersthene	Augite	Epidote	Clinozoisite	Andalusite	Sillimanite	Kyanite	Chloritoid	Chlorite	Biotite	Muscovite	Siderite	Geologic formation
Well Bal-Gf 194, Bethlehem Steel Co., Sparrows Point district, altitude 10 ft.	35 - 40	3	1	9	Tr	Tr	Tr			40	20	Tr		5	15	Tr	2	1	3					Pleistocene
	75 - 80	Tr		3	10					Tr				Tr	Tr		Tr	2		Tr			85	
	80 - 85		Tr	Tr	25					35	5		Tr	5	18			1					10	
	95 - 100	Tr		20	20					30	5	Tr		2	15		2	3			Tr	Tr	2	
	110 - 115	1	1	1	1					50	5			5	25		10		1					
	115 - 120	Tr	1	10	2		1			50	12				20	Tr	2	1						
	140 - 150	55	30	3			2			9				1		Tr			Tr					Patapsco
	162	55	30	3		2	Tr			9							1							
	175.8 - 180	50	30	10		2				3				Tr				2					2	
	190 - 195	43	44	2		5		2	Tr					Tr	2			Tr	2				Tr	
	205.8 - 209.3	45	25	3		3			Tr	15	1			2	3			1					1	
	219.3 - 224.3	55	25	3		Tr	Tr	Tr	Tr	10	2			Tr	3								1	
	303 - 311	5	4	8			Tr	Tr		3	2			2	3		1	2					70	
Samples from outcrop of Patapsco formation, Curtis Bay district, Cherry Hill Road	*Sample* 1	66	20	1		10		2						Tr	Tr			Tr				Tr		Patapsco
	2	60	30	1	Tr			8	1					Tr										
	3	47	36	3		5		5	3						Tr			Tr				Tr		
	4	45	35	3		7		5	2					Tr	1		Tr	1				Tr		
	5	51	40	2		2		3	1						Tr									
	6	75	15	1		6		2	Tr					1										
	7	65	30			4		Tr	Tr					Tr										
	8	60	35	1		3								Tr								Tr		

from 303-311 feet, which is from the lowermost part of the formation, are strikingly different, consisting largely of siderite with a small proportion of zircon, tourmaline, and staurolite.

Although most of the sediments in the Patapsco formation form irregular and lenticular beds, the data obtained from drillers' logs, drill cuttings, and other sources show that in the vicinity of Baltimore the formation can be divided into three lithologic units. These units are, in ascending order: (1) a lower part consisting of coarse sand and gravel, the gravel generally at the base immediately overlying the Arundel clay; (2) a clay bed in which the clay is compact and is predominantly dark red; and (3) an upper unit consisting chiefly of lenticular beds of sand, gravel, and clay. These units are well shown by the drilling-time curves (fig. 6), for the middle unit, the clay bed, is relatively difficult to drill in contrast to the underlying and overlying units that contain a larger proportion of sand and gravel. Although the sand and gravel in the upper and lower units appear to be similar, the heavy-mineral suites in drill-cutting samples from well Bal-Gf 194 (Table 11) are different.

The three lithologic units of the Patapsco formation are most easily distinguished in the Sparrows Point district. Plate 9, which is a geologic section of the Sparrows Point district, shows the position of the three units. Owing to a scarcity of data the units could not be identified with certainty in some other parts of the Baltimore area; however, drillers' logs suggest that the three zones are rather extensive, at least within the vicinity of Baltimore (Pl. 6).

The thickness of the Patapsco formation appears to be about 300 feet; however, as the sediments in the Patapsco formation are similar lithologically to the sediments in the overlying Raritan formation, the top of the Patapsco formation was not determined accurately. In the southeastern part of the area sediments considered to belong to the Patapsco formation may include sediments of the overlying Raritan formation. As the two formations are lithologically similar it is not important, when considering the occurrence of ground water, that they be classed as separate formations. Although these two formations have been considered as a single hydrologic unit in this report, the sediments penetrated by some wells, particularly those on the Raritan outcrop, were classified as Raritan in Table 16.

In the Sparrows Point district, where detailed information is available, the thicknesses of the lithologic units of the Patapsco formation are not uniform. The lower unit, which is an important water-bearing zone, ranges from about 10 to 100 feet in thickness (Pl. 9).

The difference in thickness of that unit is largely compensated by the thickness of the overlying clay bed, for where the lower unit is thick the clay bed is thin. The clay bed, or middle unit, probably pinches out locally southeast of the Sparrows Point district. In those places the upper and lower units may be hydrologically connected. Drillers' logs suggest that the lower unit thins from the Sparrows Point district to the northwest towards Baltimore. It may pinch out and have no outcrop in that part of the Coastal Plain (Pl. 6).

The clay bed, the middle unit, has a maximum thickness of about 75 feet, but generally it is about 25 to 50 feet thick.

The upper unit has a wide range in thickness, chiefly because it crops out in a large part of the area and has undergone erosion, but also because it was eroded before the deposition of the overlying Pleistocene sediments. In the Sparrows Point district it is about 75 to 150 feet thick, but owing to its removal by erosion it thins toward the northwest.

WATER-BEARING PROPERTIES

During the early stages of the ground-water development in the Baltimore industrial area the Patapsco formation was utilized extensively. However, in many parts of the industrial districts, intrusion of salt water from the Patapsco River contaminated the water so that pumping from the formation in these districts was largely discontinued. Nevertheless, the Patapsco formation is still an important water-bearing formation in the Sparrows Point district and in parts of the area northeast and southwest of Baltimore.

In the vicinity of Baltimore the Patapsco formation includes two main water-bearing zones, the lower and upper lithologic units. The clay bed that separates these two zones in the vicinity of Baltimore may be only of local extent, so that the two zones merge at some distance from Baltimore. Furthermore, even in the vicinity of Baltimore the clay bed may pinch out locally as it probably does in the area southeast of the Sparrows Point district, so that in some localities water may move freely from one zone to the other.

Both zones contain unconsolidated sand and gravel that is essentially similar in grade size and permeability. However, owing to a wide range in the thickness of water-bearing material, the water-bearing zones do not necessarily have similar or uniform hydrologic properties throughout the area.

Yield of Wells

The lower water-bearing zone is especially productive in the Sparrows Point district, where it yields generally about 500 to 750 gallons a minute to large-diameter industrial wells. Only a few wells in the other districts in the industrial area draw water from the lower zone; consequently, outside the Sparrows Point district, the capacity of the zone to yield water to wells cannot be evaluated accurately. However, owing to its relatively small thickness in comparison to its thickness in the Sparrows Point district, the capacity of wells probably would be less than in the Sparrows Point district. The only active industrial well of large diameter that draws water from the lower part of the

Patapsco formation within the city of Baltimore is well 6S2E-10 in the Curtis Bay district. This well, which is 144 feet deep, yields about 150 gallons a minute. Several wells (6S2E-56 to 62) in the Fairfield district had yields of from 100 to 250 gallons a minute, but those wells have been abandoned for several years.

Specific Capacity of Wells

In the Sparrows Point district the specific capacity of wells ending in the lower part of the Patapsco formation is as much as 22.5 (well Bal-Gf 175); however, values of specific capacity were determined for only six wells. The specific capacity of 22.5 for well Bal-Gf 175 probably is near the maximum as this well is in the southeastern part of the district where the water-bearing material in the lower part of the Patapsco formation is relatively thick. The other five specific capacities range from 8 to 18.

The aquifer in the upper part of the Patapsco formation is important only in the Sparrows Point district, where large-diameter industrial wells yield about 500 to 800 gallons a minute; the specific capacities of four of these wells range from 7.5 to 13. In the other industrial districts the upper part of the Patapsco formation is not an important aquifer, either because it is thin or absent or because it has been contaminated by intrusion of salt water from the Patapsco River estuary.

Although the clay bed separating these two water-bearing zones of the Patapsco formation may have an areal extent of several miles, the available data are not adequate to determine its areal extent accurately; therefore the formation is arbitrarily considered to be a single hydrologic unit outside the Baltimore industrial area.

Very few large-diameter wells draw water from the Patapsco formation in the area southwest and northeast of the industrial districts; consequently its hydrologic properties in those parts of the area are not well known. In nearly all parts of the area where the formation is present it yields adequate supplies for domestic purposes and there is no reason to believe that properly constructed large-diameter wells would not have yields similar to those in the vicinity of Baltimore. At Glen Burnie, wells AA-Ad 1 to 3, which are 62.5 to 95 feet deep and are screened in the Patapsco formation, yield from 175 to 280 gallons a minute. Well AA-Bc 1 at Odenton yields about 250 gallons a minute; and well AA-Cc 1, about 2 miles southeast of Odenton, yields about 260 gallons a minute.

Several wells (Har-Ed 4, 6, 7, 14 to 16, and 18 to 20) on Gunpowder Neck about 14 miles northeast of Baltimore yield as much as 385 gallons a minute. Most of those wells are screened at several horizons and may draw water from the Pleistocene sediments and Patuxent formation as well as the Patapsco formation. Moreover, in that part of the area all the sediments may be hydrologically connected, as drillers' logs do not show any persistent confining beds of clay.

Permeability, Transmissibility, and Storage Coefficients

Samples of drill cuttings were collected from two test wells (Bal-Gf 193 and 194) in the Sparrows Point district for determination of permeability and grade size. (Plates 10 and 11.)

The permeability of three samples from the lower part of the Patapsco formation ranges from 190 to 700 and averages about 400; the grade size is characterized by a predominance of 28-mesh to 48-mesh size, or 0.589 to 0.295 millimeter.

The permeability of eleven samples from the upper part of the Patapsco formation ranges from 270 to 1,200 and averages about 650; the grade size is slightly coarser than in the lower part of the Patapsco formation, consisting predominantly of material of 20-mesh to 35-mesh size, or 0.833 to 0.417 millimeter.

Neither the permeabilities nor the grade sizes can be considered accurate, for during rotary test drilling there is some mixing of sediments and probably some loss of very fine material. However, the procedure used in collecting these samples reduced materially the degree of contamination and loss of fine material; consequently the permeabilities and grade sizes are reasonably accurate.

Several pumping tests on wells ending in the lower part of the Patapsco formation, were analyzed for determination of coefficients of transmissibility and storage, and the coefficient of permeability was determined by dividing the coefficient of transmissibility by the thickness of water-bearing material. The coefficients are summarized in Table 12. The coefficients of transmissibility determined from pumping tests in the Sparrows Point district range from 14,300 to 29,900 and average about 25,000. The lowest value, 14,300, was obtained from a pumping test on well Bal-Gf 1, in the northwestern part of the Sparrows Point district where the sand thickness is small in comparison to its thickness in the rest of the district. The field coefficient of permeability ranges from 230 to 570 and averages 320. The coefficients of storage, which range from 0.000053 to 0.0027, probably are not accurate owing to the short duration of the pumping tests.

One coefficient of transmissibility was obtained from a pumping test in the Curtis Bay district; it is 24,300, which is surprisingly high in view of the relatively small thickness of the aquifer in that part of the area.

It is not possible to arrive at an average coefficient of transmissibility that would be representative of the formation in the entire Baltimore area. As the aquifer thins appreciably from the Sparrows Point district northwestward toward Baltimore, its transmissibility probably decreases in that direction.

The only large industrial wells ending in the upper part of the Patapsco

TABLE 12

Summary of Permeability, Transmissibility, and Storage Coefficients Determined by Pumping Tests in the Lower Part of the Patapsco Formation

Wells (pumped well is underscored)	Location	Pumping-test method	Duration (min.)	Screen length in pumped well (feet)	Effective sand thickness (feet)	Formula used for analysis[a]	Field coeff. of transmissibility (gal./day/ft.)	Coefficient of storage (cu.ft./ft.)	Field coeff. of permeability (gal./day/ft.²)	Estimate of accuracy of test[b]
6S2E-<u>10</u>	Curtis Bay district	Recovery in pumped well	108	20	25	D	24,300	-	970	G
Bal-Gf <u>1</u>	Sparrows Point district	do	25	25	25	D	14,300	-	570	G
Bal-Gf <u>175</u>	do	do	71	30	90	D	29,000	-	320	F
Do	do	do	50	30	90	D	29,900	-	330	F
Bal-Gf <u>175</u> and 168	do	Recovery interference	96	30	90	B	28,900	0.000053	320	F
Do	do	do	96	30	90	C	27,400	0.000056	300	F
Do	do	do	96	30	90	D	29,000	-	320	F
Do	do	Drawdown interference	84	30	90	B	25,600	0.00012	280	F
Do	do	do	84	30	90	C	21,600	0.00012	240	F
Bal-Gf <u>175</u> and 176	do	Recovery interference	84	30	90	C	20,500	0.0027	230	F
Bal-Gf <u>167</u>	do	Recovery in pumped well	50	-	90	D	23,400	-	260	F

[a]*B. Cooper and Jacob (1946, pp. 526-534) graphical method.*
C. Theis (1935, pp. 519-524) nonequilibrium formula.
D. Theis (1935, pp. 519-524) nonequilibrium (recovery) formula.

[b]*G - good*
F - fair

formation are in the Sparrows Point district. As these wells are screened in only a small part of the water-bearing material, pumping tests were not run on them. In this district the thickness of the sand in the upper part of the Patapsco formation is relatively large and it is likely that its transmissibility is higher than that of the lower part of the formation.

Up dip, to the northwest from the Sparrows Point district, the water-bearing material in the upper part of the formation decreases in thickness so that it probably is a relatively unimportant aquifer in the other districts.

QUATERNARY SYSTEM

PLEISTOCENE DEPOSITS

DISTRIBUTION AND CHARACTER

Pleistocene deposits consisting chiefly of sand, gravel, and clay, are present in a large part of the Baltimore area (Pl. 2). The sediments form a mantle, ranging widely in thickness, on the irregular surface of the underlying pre-Cambrian rocks and Cretaceous formations. Recent sediments are present in a few localities; they generally consist of thin fine-grained deposits. They are unimportant, and are not distinguished from the underlying Pleistocene except in a few well records.

The Pleistocene deposits in this area generally have been divided into several formations on the basis of the altitude of the terraces they form; in this report, however, the Pleistocene deposits are considered arbitrarily to comprise two ill-defined units. These are the sediments at a relatively high altitude which may be called the upland deposits, and the sediments at a relatively low altitude, which may be called the lowland deposits. There is no sharp line of distinction between the two units, but for the most part the upland unit includes all or a part of the sediments shown on published geologic maps as the Brandywine, Sunderland, and Wicomico formations, whereas the lowland unit includes mostly sediments mapped as the Talbot formation. Such an arbitrary division of the Pleistocene in this area may not be sound stratigraphically, but it is more adaptable to a discussion of the ground-water resources.

The sediments of the upland unit occur chiefly as a thin cap on high ridges or hills and not as a widespread continuous deposit; they are present in a relatively small part of the area. The unit is composed essentially of a mixture of sand, gravel, cobbles, and clay which in some localities is tightly bonded to form a consolidated conglomerate (Pls. 19 A and 23 B). Its thickness is not known accurately but does not exceed 30 feet and generally is about 10 to 15 feet.

The sediments of the lowland unit, which consist essentially of clay, sand, gravel, and cobbles, are chiefly below an altitude of about 50 feet and are exposed in a large part of the shore area of Chesapeake Bay and its estuaries. As only a relatively small part of this unit is exposed, most of the information concerning its lithology was obtained from well logs.

In the Sparrows Point district the lowland unit consists largely of dark-gray clay with lenses of sand and gravel (Pl. 9). The clay is generally underlain by a coarse gravel or cobbles that are well rounded. The dark-gray clay contains plant fragments, ostracods, *Ostrea* sp., and a large thick-shelled pelecypod, *Rangia cuneata.* The faunal content indicates that the clay was deposited in a marine or estuarine environment. The clay, which does not have the "waxy" or unctuous character that typifies the clays of Cretaceous age, is drilled easily. This is well shown by the drilling-time curves of wells Bal-Gf 193 and 194, on Plates 10 and 11. The drilling time per foot for well Bal-Gf 194 (Pl. 11) was low, down to a depth of 132 feet, even though the well penetrates clay through most of this interval; however, at 132 feet, where the drill apparently encountered a thin clay bed of Cretaceous age, the drilling time increased markedly. In the Curtis Bay and Fairfield districts the unit is much thinner but is composed of essentially the same proportion of materials as in the Sparrows Point district.

The lithologic content of the lowland unit is not as well known in most of the remaining parts of the area, northeast of the Patapsco River estuary, chiefly because the available data are inadequate for locating the base of the unit. However, well logs generally indicate that material, probably of Pleistocene age, contains a much larger proportion of sand and gravel northeast of the river than is present in the Pleistocene in the Sparrows Point, Curtis Bay, and Fairfield districts. Thus well Har-De 18, at Aberdeen, penetrated 61 feet of Pleistocene sediments that consisted almost entirely of sand and gravel. The wells at the Aberdeen Proving Ground (wells Har-De 6, 7, 19, and Df 1 to 25) penetrate Pleistocene sediments of which a large part consists of coarse sand and gravel. Well Har-Cf 2, at Havre de Grace, penetrated 58 feet of Pleistocene sediments that contain mostly coarse sand and gravel, and some cobbles as much as 2 inches in diameter. If adequate data were available they probably would show that Pleistocene sediments have a wide range in grade size of the coarse clastics and in the proportion of sand to clay.

The lowland unit of the Pleistocene deposits has a wide range in thickness. It is absent in some places and as much as 150 feet thick in others. Plate 12 shows by contours the approximate thickness of this unit in the vicinity of Baltimore. In general the unit thickens from northwest to southeast toward Chesapeake Bay. In the northern part of the Baltimore area, near the western edge of the Coastal Plain, well Har-Df 18, at Aberdeen, penetrated 61 feet of Pleistocene sediments without encountering the base. At Havre de Grace, well Har-Cf 2, also near the western edge of the Coastal Plain, penetrated 58 feet of Pleistocene sediments before encountering the underlying pre-Cambrian rocks. Wells at the Aberdeen Proving Ground, which are from 2 to 6 miles southeast of Aberdeen, penetrate a considerable thickness of Pleistocene deposits, but the available data are not sufficiently detailed to show the exact thickness. It is likely, however, that in some parts of this district the thickness is at least 100 feet. For example, McGee (1888, p. 594) reports that a well at Fishing Battery Station, about 3 miles south of Havre de Grace, penetrated 140 feet of alluvial sands (these sediments probably are of Pleistocene age) without reaching their base.

ORIGIN OF SEDIMENTS

Until recently the Pleistocene sediments in this area were generally considered to be entirely or largely of marine origin, forming terraces at successively lower altitudes, in accordance with the position of sea level as determined by the volume of water stored in the glacial ice cap. Shattuck (1901) named the three lower terraces, in descending order, the Sunderland, Wicomico, and Talbot. To the highest Pleistocene terrace he applied the name Lafayette; the terrace is now called the Brandywine. The Pleistocene deposits were named after the terraces and are so shown on geologic maps, although it was recognized that these formations were not necessarily different lithologically. However, Flint (1940) recently reexamined the previous literature and made field studies of the Pleistocene deposits in Maryland and Virginia, concluding in part (p. 783):

> "The mass of sediments covered the Chesapeake Bay region, and extended westward up such main streams as the Susquehanna, Potomac, and James Rivers. The sediments appear to have been continuous with the alluvial sediments of eastern New Jersey. Their broad plain surface, seemingly a complex of coalescent fans and broad surfaces of stream planation of alluvial deposits, sloped gently southeastward into the sea, in a zone through which marine and fluvial facies must have interfingered. The fine sediments carrying marine fossils, that occur at low elevations in the seaward parts of this region, are thought to belong at least in part to the marine facies of these deposits. The sea, probably very largely aided by streams, has cut away enough of the distal portion of these deposits so that little of their marine facies remains above present sea level; most of what lies west of the present shore line is fluvial. On the other hand, these marine sediments may be in part somewhat younger than the fluvial deposits, representing a slight marine encroachment post dating the dominantly fluvial sedimentation."

It was not within the scope of this investigation to make a detailed study of the origin of the Pleistocene sediments; however, some of the features observed in connection with the study of the ground-water resources may be helpful to those studying the sequence of events during the Pleistocene epoch.

The thickness of as much as 150 feet of Pleistocene deposits in the Baltimore area is much greater than has been generally reported and indicates that during a part of Pleistocene time the sea level was considerably lower than at present. Flint (1940, p. 784) points out that Veatch and Smith (1939, p. 44; Charts IB, IIB, and IIIB) identified a feature on the continental shelf as the "Franklin Shore", which is at a depth of about 240 feet in the latitude of lower Chesapeake Bay and about 330 feet in the latitude of Philadelphia. This feature may indicate a former position of the sea during which time the land area might have been deeply eroded.

A large part of the lowland unit of Pleistocene deposits (shown as the Talbot formation on most published geologic maps) is probably closely related to the history of the Susquehanna River (Chesapeake Bay) and its tributaries. The increased thickness of this unit from northwest to southeast toward Chesapeake Bay indicates that during some time in the Pleistocene epoch (during a glacial stage) the channel of the Susquehanna River, in the Chesapeake Bay area, was deeply eroded and then later, during an interglacial stage, was invaded by the sea and the marine sediments were deposited. The contours shown on Plate 12 suggest that at one time the old Susquehanna River passed through or near the Sparrows Point district and then abruptly turned southeastward. The eastern shore of Marley Neck forms a long arcuate curve, suggesting that it may have been formed by the Susquehanna River late in Pleistocene time (Pl. 12).

Although a large part of the sediments in the old channelway of the Susquehanna River apparently were deposited in a marine environment, it is likely that the coarse gravel and cobble bed at or near the base of the Pleistocene, for example in the Sparrows Point district, is of fluvial origin. The other Pleistocene sand and gravel deposits, particularly those northwest of the Chesapeake Bay shore area, probably are also of fluvial origin. Flint's (1940, p. 783) suggestion that the marine sediments may be in part somewhat younger than the fluvial deposits seems reasonable; however, additional well logs and samples of drill cuttings are needed to provide a more detailed and complete knowledge of the Pleistocene history in Maryland.

WATER-BEARING PROPERTIES

Yield and Specific Capacity of Wells

The upland unit of the Pleistocene sediments is not an important water-bearing formation chiefly because it is thin and occurs as a cap on hills and ridges. Owing to its high topographic position and to its dissection, it is not capable of storing large quantities of ground water. Nevertheless, small supplies of water, adequate for domestic use, can usually be obtained from it through dug wells on the higher and flatter parts of the hills or ridges.

As this unit covers only a relatively small part of the area and is an unimportant aquifer, it is not considered further in this report.

The lowland unit of the Pleistocene deposits contains considerable coarse water-bearing material; but, in the vicinity of Baltimore, along the Patapsco River estuary, the sediments are largely contaminated with salt water so that, in this part of the area, the unit is no longer utilized as an important source of water supply. In the early days of ground-water development in the vicinity of Baltimore, the lowland unit of the Pleistocene sediments was used as a source of water supply for industrial purposes. Wells Bal-Gf 42, 43, 47, 58, 62, 66, 69, and 141 to 153 in the Sparrows Point district probably end in sand and gravel of Pleistocene age. These wells, now abandoned, had yields of about 25 to 50 gallons a minute, but they were drilled many years ago when well-construction methods were not as efficient as at present so that the reported yields probably do not indicate the maximum capacity of the water-bearing formation to yield water to wells. The only large-capacity industrial well now drawing water from sediments of Pleistocene age is well Bal-Gc 1, a collector-type well, which is reported to have a yield of 1,000 gallons a minute.

In general the most permeable water-bearing material in the Pleistocene sediments is in the northeastern part of the area in and near the Aberdeen Proving Ground. At Aberdeen well Har-De 18 is reported to have a yield of about 500 gallons a minute and a specific capacity of 21.3 gallons per foot of drawdown. Well Har-Cf 2, at Havre de Grace, had a yield, during a pumping test on November 1, 1943, of 100 gallons a minute and a specific capacity of about 65 gallons per foot of drawdown. Many of the wells at the Aberdeen Proving Ground (wells Har-De 6, 7, 19; Har-Df 1 to 25) derive all or a part of their water from sand and gravel of Pleistocene age. Inasmuch as these wells have yields of as much as 645 gallons a minute the Pleistocene sediments in this part of the area are very permeable.

Permeability and Transmissibility Coefficients

Grade size and permeability were determined on five samples of drill cuttings of the Pleistocene sediments from two test wells (Bal-Gf 193 and 194) in the Sparrows Point district (Pls. 10 and 11). The permeability coefficient of the samples ranges from 540 to 13,300 and averages about 5,700. The grade size is characterized by a large percentage coarser than 8-mesh (2.36 mm.).

Water-level data obtained during a pumping test, by the Ranney Water Collector Corp., on shallow test wells ending in the Pleistocene in the general vicinity of well Bal-Fe 25, were analyzed by the Thiem formula. The coefficient of transmissibility was computed to be 14,500 and the field coefficient of permeability about 900.

A pumping test for the determination of the coefficients of transmissibility and permeability was run on well Har-Cf 2 at Havre de Grace. The test data, analyzed by the Theis nonequilibrium (recovery) formula, indicate that the coefficient of transmissibility is about 200,000 and the field coefficient of permeability about 6,300.

These wide differences in transmissibility and permeability indicate that the water-bearing material in the lowland unit of the Pleistocene deposits probably has a very wide range. In general it is sufficiently permeable to yield large quantities of water to large-diameter wells; in a large part of this aquifer the possibility of salt-water encroachment probably is the most important factor limiting development.

OCCURRENCE OF GROUND WATER

GENERAL PRINCIPLES

The science of ground-water hydrology, or geohydrology, has become so well developed that a large number of definitions have been formulated to provide a convenient "language" for describing ground-water conditions. Many of these definitions, however, are not applicable to the ground-water conditions in the Baltimore area. The ground-water terms used in this report are defined where they first appear in the text.

The principles of ground-water hydrology have been discussed in detail by Meinzer (1923A, 1923B), Tolman (1937), Wenzel (1942), Hubbert (1940), and others. Only a brief statement regarding the principles of the occurrence of ground water is included in this report.

The main supplies of ground water in the Baltimore area are in the porous rocks, such as the sand and gravel deposits in the Coastal Plain and the fractured and weathered crystalline rocks in the Piedmont Plateau. The ground water contained in these rocks is derived chiefly from precipitation. A part of the precipitation runs off on the land surface and enters streams; a part is evaporated or used by plants; and a part, generally called recharge, passes through pores and openings in the rocks and enters a zone in which the rocks are saturated. The water in this zone of saturation, called ground water, generally is stored only temporarily, for it moves slowly to nearby streams or through other ground-water reservoirs and eventually is discharged into streams or other bodies of water on the land surface, or directly into the atmosphere.

Ground water is generally considered to occur under either of two conditions: water-table (nonartesian) and artesian. Water-table conditions occur (1) where porous and permeable rocks that make up the ground-water reservoir or aquifer are not overlain by impervious rocks, so that water from precipitation may enter the reservoir by direct downward percolation; or (2) where, though impermeable rock overlies the permeable rock the upper part of the permeable rock is not saturated. The upper surface of the zone of saturation in this type of ground-water reservoir is called the water table and its position is marked by the water levels in wells tapping the aquifer.

Under artesian conditions water is confined under hydrostatic pressure by relatively impervious rock. If the artesian reservoir is penetrated by a well the water will rise in the well above the bottom of the confining bed. Any well tapping an artesian aquifer is considered an artesian well; thus there are both flowing and nonflowing artesian wells. Furthermore, contrary to popular belief, not all deep wells are necessarily artesian. As the water in an artesian aquifer is confined by essentially impervious rock there is no "free" water surface or water table; instead, there is an imaginary surface, called the piezometric surface, that coincides with the level to which the confined ground water rises in wells.

In the Baltimore area water-table conditions occur in the outcrop areas of the water-bearing formations. Artesian conditions prevail in the area southeast of the outcrop areas where the formations are overlain by impervious material. Most of the water-bearing formations in the Baltimore area form ground-water reservoirs in which water-table conditions occur in the outcrop area and artesian conditions in the remaining part.

Water-table and artesian aquifers differ markedly. Most water-table aquifers function chiefly as storage reservoirs that are replenished by direct downward percolation of water from precipitation. As the water table declines in aquifers like the Patuxent and Patapsco formations in the Baltimore area, large quantities of water are drained from the water-bearing material. In an area of such high rainfall as the Baltimore area, the water table is so high in some places that water from precipitation is rejected and runs off on the land surface. This water, called rejected recharge, indicates that the rate of recharge on the outcrop area may be potentially greater when the water table is at a lower level. During periods of little or no rainfall the quantity of water discharged into streams crossing the outcrop area, plus the quantity evaporated or transpired by plants, and the quantity transmitted down the dip into the artesian aquifer, exceed the rate of recharge and consequently the water table in the outcrop area declines. Without recharge this decline would persist until the water table declined to sea level and the streams became dry. Generally, as in the Baltimore area, precipitation occurs and replenishes the reservoir before such conditions are reached.

Artesian aquifers in the Baltimore area serve chiefly as conduits that transmit water from the outcrop, or water-table area, to outlets of natural or artificial discharge. In general water is discharged naturally by upward seepage over a large area through the overlying confining beds and artificially through wells. The artesian aquifers contain a very large quantity of water but, in a practical sense, the storage is very small because it generally is not feasible to lower water-levels in wells below the bottom of the confining bed in order to recover this water by draining the sediments. In the Baltimore area, the artesian aquifers contain practically the same quantity of water as always, even though large quantities of water have been withdrawn from the aquifers for many years.

Although in an artesian aquifer water is not generally available from storage by drainage from the saturated material, some water is released from storage when the hydrostatic pressure declines, owing to the compressibility and elasticity of the aquifer and adjacent confining beds, and to the slight expansion of the water itself. This storage factor for artesian aquifers is called the coefficient of storage and generally is only in the order of a thousandth of the coefficient of storage (specific yield) in the outcrop area. Nevertheless, if the reduction in hydrostatic pressure is large over a wide area, the quantity of water contributed from artesian storage may be a large part of the water withdrawn from the aquifer for a long period of time.

Before wells were drilled to the ground-water reservoirs in the Baltimore area the hydraulic system, represented by the replenishment or recharge of water in the outcrop area, the transmission of the water through the aquifer, and the natural discharge through the overlying confining beds, was well balanced; the hydrostatic pressure was sufficiently high to force fresh water into the bodies of salt water at the land surface, thus preventing contamination. Moreover, the natural discharge of water was equal to the average rate of recharge on the outcrop area.

An increase in discharge caused by pumping wells places a burden on the hydraulic system that has to be balanced by an increase in recharge, a decrease in natural discharge, a reduction in the quantity of water stored in the aquifer, or all three. If the pumping is to continue at the same rate indefinitely, there must be a corresponding increase in recharge or decrease in natural discharge. If such an adjustment is not possible, the rate of pumping must eventually decrease until it is equal to the quantity of water made available for artificial discharge by the increase in recharge and the decrease in natural discharge. During the adjustment the water table or piezometric surface is lowered over a large area. If the water table or piezometric surface is lowered below sea level in an area where surface bodies of salt water are connected hydrologically with the reservoirs, the aquifers will become contaminated with highly mineralized water. This has occurred in a part of the Baltimore area. Thus one of the chief objectives of a ground-water investigation is to describe the ground-water developments and the changes in the ground-water reservoirs produced by these developments, and to provide a hydrologic analysis of the resulting conditions so that additional ground-water development and correction of existing ground-water problems can be carried forth effectively.

The preceding classification of aquifers and discussion of the general principles of the occurrence of ground water have been greatly simplified. The following sections contain a more detailed description and analysis of the occurrence of ground water in the Baltimore area and some of the data and interpretations make necessary some modification of the preceding more general statements.

GROUND-WATER DISCHARGE

In the Baltimore area ground water is discharged both naturally and artificially. Water is discharged naturally over a large area, whereas the artificial discharge, consisting of withdrawal through wells, is confined to certain localities.

NATURAL DISCHARGE

Most of the natural discharge is in the outcrop area of the water-bearing formations where ground water is discharged chiefly through springs and by seepage into streams, and through evaporation and transpiration. As the natural discharge of ground water maintains the flow of the streams during periods of little or no rainfall, the approximate rate of discharge to streams may be determined directly by stream-flow measurements across the outcrop of the aquifer during prolonged dry periods. The rate of discharge by evaporation and transpiration is much more difficult to determine directly because it is not uniform over a large area. The natural discharge to streams and the quantity of water discharged by evapo-transpiration are not constants; they vary in accordance with the amount and intensity of precipitation and many other factors. Hence, the natural discharge in the outcrop area can be determined accurately only from observations over a period of many years.

With respect to most of the ground-water developments in the Baltimore area the exact rate of natural discharge in the outcrop area is more of academic than of practical value. The observation that a large part of the precipitation is eventually discharged naturally in the outcrop area is entirely adequate even for a quantitative analysis of the ground-water reservoirs in the Baltimore area.

The natural discharge to streams usually is greatest in the spring when the rainfall is high and before plant growth is fully developed. The discharge by evaporation and transpiration by plants is highest in late summer or early fall when plants are larger and foliage is more dense. In the winter discharge by transpiration practically ceases.

Water is discharged naturally from the artesian aquifers in some parts of the Baltimore area by seepage through the confining beds into other ground-water reservoirs or into the atmosphere. The rate of this discharge depends primarily on the difference in altitude between the hydrostatic head of the artesian aquifer and the water table in the sediments near the land surface, and on the permeability and thickness of the material through which the water passes. In those parts of the area where pumping has lowered the hydrostatic pressure in the artesian aquifer below the altitude of the water table there can be no natural discharge upward; instead water in the surficial deposits may move downward.

DISCHARGE FROM WELLS

GENERAL HISTORY OF PUMPING

In the Baltimore area ground-water supplies were first developed in sizeable quantities in about the middle of the 19th century and practically all this development was in or near Baltimore. Very few records of pumpage are available for most of this period of about 100 years. However, by piecing together fragments of information and making evaluations based on the number of wells and their reported yields a rough approximation of the pumpage was made. It is estimated that the pumpage increased gradually from practically nothing in about 1850 to about 5,000,000 to 10,000,000 gallons a day in 1900 in the Harbor and Canton districts and about 1,000,000 to 2,000,000 gallons a day in the other industrial districts. After this the pumpage increased only slightly until about 1915, when it was increased considerably in the Sparrows Point, Dundalk, Canton, and Curtis Bay districts but probably was decreased in the Harbor district. The total pumpage at that time was about 15,000,000 gallons a day.

The pumpage increased gradually after World War I until about 1935, after which it increased rapidly, reaching a total of approximately 47,000,000 gallons daily early in 1942 in the Baltimore industrial districts. Late in 1942 the pumpage was decreased by about 10,000,000 gallons a day in the Sparrows Point district and about 3,000,000 gallons a day in the Curtis Bay district. Thus the total pumpage in the Baltimore industrial area was about 34,000,000 gallons a day after 1942 and has not changed materially since.

Pumpage in the remaining part of the area was relatively small until World War I, when ground-water supplies were developed at the Aberdeen Proving Ground near Aberdeen, and the Army Chemical Center near Edgewood, which are the localities of largest ground-water withdrawal outside the Baltimore industrial districts. The estimated total pumpage from all sources outside the Baltimore industrial area increased from 3,000,000 gallons a day in 1942 to 5,000,000 in 1945.

AREAL DISTRIBUTION OF PUMPAGE IN 1945

An inventory of pumpage was made in the latter part of 1945 in order to determine the average pumpage during 1945, at each industrial plant, public supply, or military establishment, the principal consumers of ground water in the area. It was found that only a small percentage of the pumpage was metered, so that for the most part estimates had to be made. Some estimates, based on the number of hours wells were reported in operation multiplied by the measured yields of the wells, are reasonably accurate; others may be greatly in error.

Most of the figures for pumpage have not been rounded off, as perhaps they should be to avoid the impression of extreme accuracy. The figures for some of the industrial plants may be in error by as much as 25 percent, but as these errors would be largely compensating, the total pumpage shown for each district probably is correct to within 10 percent.

Figure 8 shows the distribution of pumpage, during 1945, in the industrial districts in and near Baltimore. Pumpage from the pre-Cambrian crystalline rocks totalled about 700,000 gallons a day, of which all was pumped by industries in the northern part of Baltimore where the crystalline rocks crop out. Pumpage from the Patuxent formation totalled 28,600,000 gallons a day, of which about 70 percent was from wells in the Sparrows Point, Dundalk, Curtis Bay, and Fairfield districts. Pumpage from the Patapsco formation totalled 3,500,000 gallons a day, of which 80 percent was from wells in the Sparrows Point district. Wells ending in the Pleistocene deposits were pumped at the rate of 1,400,000 gallons a day; nearly all this pumpage was from one industrial well at St. Denis.

PUMPAGE IN BALTIMORE INDUSTRIAL DISTRICTS

Sparrows Point District

Practically all the water pumped from the Sparrows Point district was from wells at the Bethlehem Steel Co. During 1945 the average of pumpage at this plant was 10,200,000 gallons a day, of which 7,500,000 gallons a day was derived from the Patuxent formation and 2,700,000 gallons a day from the Patapsco formation. Early in 1942 the pumpage reached 20,000,000 gallons a day, but later in the year it was decreased to 10,200,000 gallons a day.

The only other pumping of any consequence from nondomestic wells in this district is at Fort Howard, where about 100,000 gallons a day was pumped from the Patapsco formation. The Bay Shore Amusement Park, Inc., had two wells equipped with pumps, one tapping the Patuxent formation and the other the Patapsco formation; during 1945 the pumpage from these wells was negligible.

Dundalk District

The total pumpage of 5,100,000 gallons a day in the Dundalk district is from wells, ending in the Patuxent formation, at several industrial plants. The largest consumers are the Western Electric Co. which, during 1945,

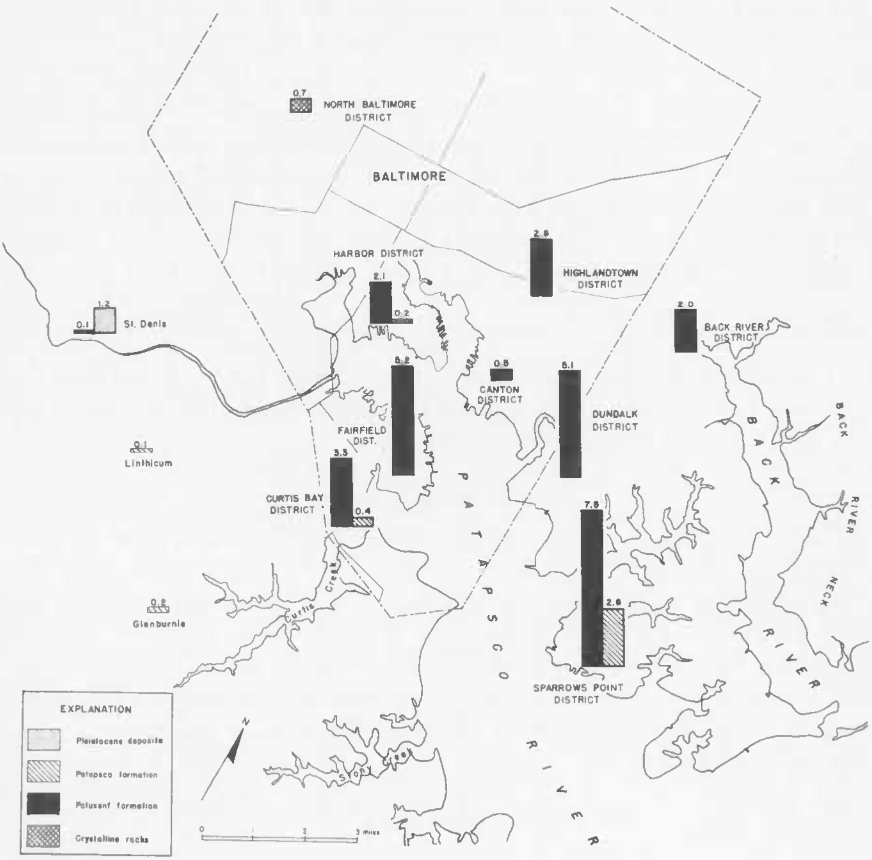


FIGURE 8. Map showing, in graphic form, the approximate ground-water pumpage during 1945, in the Baltimore industrial area (million gallons a day)

pumped 1,500,000 gallons a day; the Chemical and Pigment Co. which pumped 2,000,000 gallons a day; and the Federal Yeast Corp. which pumped 1,000,000 gallons a day. The other industries in this district that use ground water are the Reid-Avery Co. and the Baltimore Pure Rye Co. at which the pumpage was, respectively, 150,000 and 400,000 gallons a day.

Canton District

Pumpage in the Canton district, which totaled 500,000 gallons a day, is all derived from the Patuxent formation. The consumers of ground water in this district, during 1945, were the Baugh Chemical Co., the American Radiator and Standard Sanitary Corp., and the National Brewing Co., which pumped, respectively, 100,000, 250,000, and 150,000 gallons a day.

Back River District

Pumpage in the Back River district, which totaled 2,000,000 gallons a day, was derived from wells at one industrial plant, the Eastern Stainless Steel Corp. All the wells end in the Patuxent formation.

Highlandtown District

The total pumpage in the Highlandtown district was 2,800,000 gallons a day, all of which is derived from wells ending in the Patuxent formation. The largest user of ground water in this district was the Crown Cork and Seal Co., Inc., which used 1,800,000 gallons of water a day. The Wm. Schluderberg-T. J. Kurdle Co. pumped 800,000 gallons a day and Paul Jones and Co., Inc., pumped 120,000 gallons a day. The remainder of the pumpage, 80,000 gallons a day, was used chiefly by the Pennsylvania Water and Power Co. and the Monarch Rubber Co.

North Baltimore District

The name "North Baltimore" refers to that part of Baltimore in which ground water is derived for industrial use from the pre-Cambrian crystalline rocks. The total pumpage in this district was 700,000 gallons a day, of which a large part was used by the Frank G. Schenuit Rubber Co.

Harbor District

During 1945 the total pumpage in the Harbor district was 2,300,000 gallons a day, of which 2,100,000 gallons a day was derived from the Patuxent formation and 200,000 gallons a day from the Pleistocene deposits. The largest users of ground water were the Chesapeake Paperboard Co. and the Procter and Gamble Manufacturing Co., which pumped, respectively, 1,300,000 and 400,000 gallons a day from wells ending in the Patuxent formation. The remaining 400,000 gallons a day pumped from the Patuxent formation in this district was divided about equally among the James Distillery, Inc., Independent Ice Co., Carr-Lowrey Glass Co., and Mutual Chemical Co. The pumpage of 200,000 gallons a day from the Pleistocene deposits in this district was from wells at two plants—the Mutual Chemical Co., which pumped 150,000 gallons a day, and the National Distillers Products Corp., which pumped 50,000 gallons a day.

Fairfield District

During 1945 the total pumpage in the Fairfield district was 5,200,000 gallons a day, all of which was derived from the Patuxent formation. The largest ground-water use was at the U. S. Industrial Chemical Co., Fairfield plant; Continental Oil Co.; and Bethlehem Steel Co., Baltimore shipyard. The pumpage at these industrial establishments was, respectively, 2,000,000, 1,500,000, and 1,000,000 gallons a day. The other industries in this district that used ground water are the F. S. Royster Guano Co., the Maryland Drydock Co., the Brooklyne Chemical Works, Inc., and the Pan American Refining Corp.; their pumpage was, respectively, 50,000, 150,000, 350,000, and 150,000 gallons a day.

Curtis Bay District

The total pumpage in the Curtis Bay district was 3,700,000 gallons a day, of which 3,300,000 gallons a day was derived from the Patuxent formation and 400,000 gallons a day from the Patapsco formation. The principal users were the U. S. Industrial Chemical Co., Curtis Bay plant, and the Davison Chemical Corp., which used, respectively, 2,000,000 and 750,000 gallons a day. Charles S. Walton & Co., Inc., used 50,000 gallons a day, and the remainder, 500,000 gallons a day, was divided almost equally between Kavanaugh Products, Inc., and the Standard Wholesale Phosphate and Acid Works, Inc.

Of the 400,000 gallons a day pumped from the Patapsco formation, 150,000 was pumped from wells at Charles S. Walton & Co., Inc., and 250,000 from wells at the U. S. Industrial Chemical Co., Curtis Bay plant.

St. Denis District

The pumpage from the St. Denis district, which totaled 1,300,000 gallons a day, is from wells at two industrial plants. Of this total, 1,200,000 gallons a day is derived from a single well penetrating the Pleistocene deposits at the Calvert Distilling Co. and 100,000 gallons a day from the Patuxent formation at the Monumental Distillers, Inc.

Glen Burnie-Linthicum District

The total pumpage at the towns of Glen Burnie and Linthicum was 300,000 gallons a day, all of which was derived from the public-supply wells of the Anne Arundel County Sanitary Commission. All the water is derived from the Patapsco formation.

PUMPAGE IN AREA OUTSIDE THE INDUSTRIAL DISTRICTS

The main centers of pumping north of the industrial districts in the vicinity of Baltimore are at Havre de Grace, Aberdeen, Belcamp, and Edgewood. (For locations see Plate 3.)

The total pumpage at Havre de Grace was 1,000,000 gallons a day, from wells at the Harford Distillery Co. All this water is derived from the Pleistocene deposits.

The pumpage at and near Aberdeen was 1,200,000 gallons a day, of which 1,000,000 gallons a day was pumped at the Aberdeen Proving Ground and the remainder from the public-supply well field at Aberdeen. The available data were not adequate to classify the sediments underlying the Aberdeen Proving Ground according to geologic age, so that the pumpage from each water-bearing formation is not known. A large part of the pumpage probably is from the Pleistocene deposits and the remainder from sediments of the Patuxent and Patapsco formations. The public supply at Aberdeen is derived from wells ending in the Patuxent formation.

At Belcamp, 100,000 gallons a day was pumped chiefly for public-supply use. All this water is derived from the Patuxent formation.

The major user of ground water in the vicinity of Edgewood is the Army Chemical Center. Here the pumpage was 1,700,000 gallons a day, most of which probably was derived from the Patapsco formation and a small amount from the Patuxent formation.

In the area south of the industrial districts in and near Baltimore the chief centers of pumpage are near Laurel, at Odenton, and at Crownsville. However, the combined pumpage at all these localities is relatively small, not exceeding 500,000 gallons a day. Most of this water is derived from the Patapsco formation and a small amount is from the Patuxent formation.

PUMPAGE FROM DOMESTIC WELLS

Only a small part of the pumpage is from domestic wells; consequently, no attempt was made to determine accurately the quantity of water pumped for domestic use during 1945. A reasonable estimate, however, would be 1,000,000 gallons a day for the entire area, of which the largest proportion would be in the southern part of the area, chiefly in Anne Arundel County.

SUMMARY

The total pumpage from all sources in the entire area during 1945 was 39,000,000 gallons a day. About 85 percent was pumped in the relatively small part of the area in and near the industrial districts in the vicinity of Baltimore. The pumpage, in gallons a day, from each water-bearing formation was approximately: pre-Cambrian crystalline rocks, 1,000,000; Patuxent formation, 30,000,000; Patapsco formation, 6,000,000; and Pleistocene deposits, 3,000,000.

By far the largest part of the ground water pumped was used by industrial plants for cooling, production of steam, washing, and processing.

WATER-LEVEL FLUCTUATIONS

In the Baltimore area water levels in wells, which are a measure of the artesian pressure or the position of the water table, fluctuate constantly in response to many forces. These forces, which result from both artificial and natural processes, vary in direction, time, and magnitude; consequently the fluctuations often form an irregular and complicated pattern. Nevertheless, an accurate record and a detailed analysis of the fluctuations are an essential part of a quantitative study of ground-water resources, much as records of voltage or temperature are essential to the study of electrical and heat problems.

In the past the well owners in the Baltimore area generally made no systematic measurements of water levels in wells, so that detailed water-level records over a long period of time are practically nonexistent. During 1943-45 86 observation wells were established, of which 11 were equipped for various periods of time with automatic water-level recorders (Pl. 24 A). The daily high and low water levels as determined from the recorder charts, together with other water-level measurements, are given in Table 17. In addition to the water-level measurements from automatic recorders, 2,161 individual measurements were made by use of a steel tape, air line and pressure gage, or electrical tape. As it was necessary to use existing wells that were abandoned or pumped infrequently, it was not possible to establish observation wells at all desired locations.

CAUSES OF FLUCTUATIONS

The water table in the outcrop area of the water-bearing formations, where not affected by pumping, fluctuates in accordance with the rate of recharge from precipitation and the rate of discharge by seepage into streams, movement of water down the dip, and evaporation and transpiration through plants. Farther down the dip, in the artesian parts of the aquifers, the fluctuations caused by recharge or natural discharge in the outcrops are progressively less pronounced; in most of the artesian part of the Baltimore area variations in the precipitation probably cause no appreciable fluctuations in the artesian pressure. Nevertheless, water levels fluctuate in many artesian wells even though they are not affected by pumping. For example, artesian wells function like barometers—the water level in them fluctuates with the barometric pressure. When the barometric pressure increases, the additional weight of the air column depresses the water level in the well; when the pressure decreases and the air column is lighter the water level rises. No special study was made of this fluctuation in the Baltimore area, but it is likely that the amplitude of the fluctuations caused by changes in barometric pressure usually are less than a foot.

An application of heavy weight on the land surface above an artesian aquifer may compress the aquifer, causing the water levels in wells to rise; when the load is removed the water levels decline. This feature is demonstrated clearly by detailed water-level records in the Baltimore area, where water-level fluctuations caused by loading at the land surface have been produced by moving of heavy machinery, tides, and trains. Examples of these fluctuations obtained by use of automatic water-level recorders are shown in Figure 9. A well

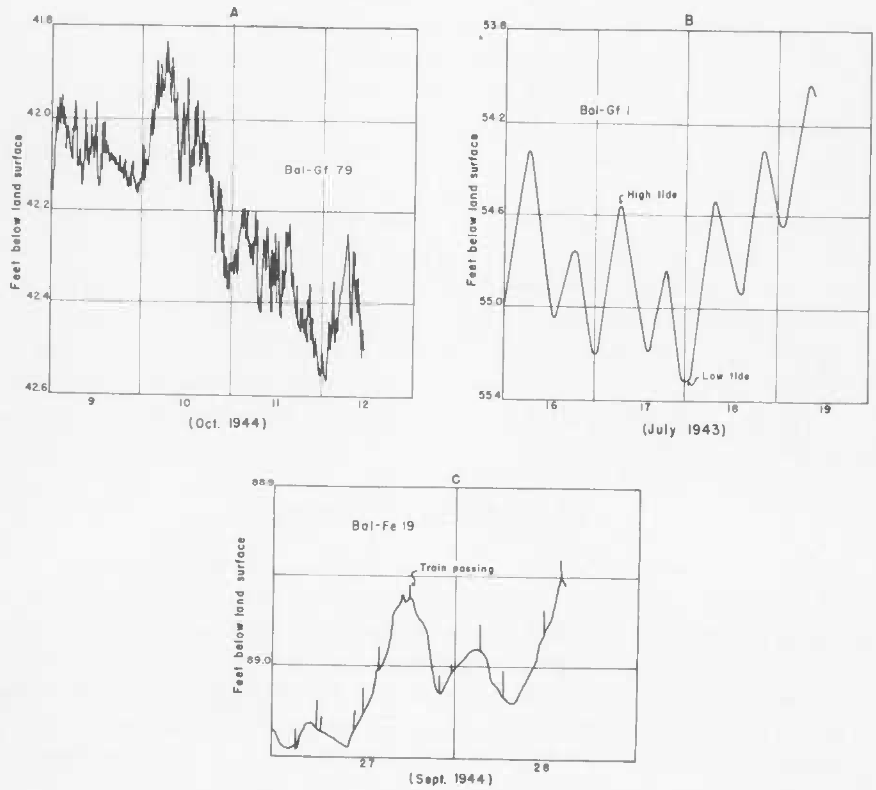


FIGURE 9. Graph showing water-level fluctuations caused in part by compression of an aquifer: A, abrupt fluctuations caused by movement of heavy machinery; B, fluctuations caused by tides; C, fluctuations caused by trains

(Bal-Gf 79) in which fluctuations are produced by the movement of heavy machinery is in the Bethlehem Steel Co. plant in the Sparrows Point district. In this well the almost constant movement of heavy cranes and trains carrying heavy loads causes the water level to fluctuate so rapidly that the fluctuations could not be recorded separately on the recorder graph at the time scale used.

A well (Bal-Gf 1) in which fluctuations are caused by the changes in the loading effect of tidal water is in the Sparrows Point district about 400 feet from the estuaries formed by the Patapsco River and Humphreys Creek; however, the water levels in other wells that are much farther from tide water also fluctuate with the tide. A well (Bal-Fe 19) in which the water level fluctuates when trains pass is in the Dundalk district about 30 feet from the railroad tracks (Pl. 24 A).

The fluctuation of water level in response to loading at the land surface shows that the artesian aquifer is slightly elastic and capable of being compressed without appreciable permanent deformation when loads like those described act upon it. However, the relation of water levels to changes in barometric pressure indicates that the aquifer acts also as a rigid body. Jacob (1940, pp. 582-584) has shown that under ideal conditions the tidal efficiency and barometric efficiency of an artesian well are complements and together equal unity. The tidal efficiency is the ratio of the rise in water level to the rise in tide corrected for density; and the barometric efficiency is the ratio of the rise in water level to the decrease in barometric pressure, measured in feet of water.

The largest fluctuations of the water levels in artesian wells, and in water-table wells in some parts of the area, are caused by changes in the rates of pumping, particularly where the observation well is close to a well that is pumped intermittently or periodically.

GENERAL HISTORY OF FLUCTUATIONS OF WATER LEVELS IN THE BALTIMORE INDUSTRIAL AREA

Prior to the development of ground water by wells in the Baltimore area the aquifers were in a state of approximate dynamic equilibrium, in which the natural discharge equaled the average recharge from precipitation. During periods in which there was little or no precipitation the water that was discharged was derived chiefly from the great quantity of water stored in the aquifer and the water table declined, showing that the hydraulic system was temporarily unbalanced. However, this unbalance was corrected by a recurrence of recharge from precipitation and a gradual reduction in the natural discharge. Thus, the water table in the outcrop areas fluctuated in accordance with the rate of recharge and natural discharge. The natural pattern of water-table fluctuations in the Baltimore area is characterized by a high water table in early spring when the rate of recharge is high and evaporation and transpiration small, and a low water table in late summer when the rate of recharge is low and the rate of evaporation and transpiration is high.

The fluctuations of the artesian pressure in the Baltimore area, before the development of ground-water supplies, probably were relatively small, mostly tidal. The available data are too incomplete to indicate accurately the height to which water would rise in wells ending in the artesian aquifers in the Baltimore industrial area before pumping began. It seems likely that in general the artesian head was about 15 to 25 feet above sea level, for many wells drilled at localities at which the land-surface altitude is 10 feet or less at one time had natural flows.

So far as could be determined there was no general decline in the water levels in the Baltimore industrial area until after 1900. Before that time, most of the ground-water development was in or near the Harbor district. In that district the water table or artesian head probably declined as much as 50 feet before 1900. The trend of the artesian head, between 1940 and 1945, in four of the industrial districts is shown in Figure 10. Most of the water levels shown on the graphs in Figure 10 were reported by well drillers or by the well owners; many of the water levels are reported as approximate and for some the exact locations of the wells in which the water levels were measured are not indicated. For these reasons all the water levels were plotted, and a line indicating the general trend was drawn through the center of the mass of points, which plot in a rather scattered manner on some of the graphs. The resulting curves are therefore, indicative only of the general magnitude of the rate of decline or rise.

The graphs show that about 1900 the artesian head of the Patuxent formation was near the land surface throughout most of the districts. About 1900 the artesian head of the Patapsco formation was about 25 feet below the land surface in the Sparrows Point district and probably was only a few feet below the land surface in the other districts.

The trend of the artesian head in the Patuxent formation after 1900 probably is shown best by the graph of water levels for the Sparrows Point district. There the water level declined slowly until about 1930, when it was about 45 feet below the land surface; after that time the water level declined more rapidly, reaching a level of about 160 feet below the land surface in 1941-42. Late in 1942, the Bethlehem Steel Co. reduced its pumping from the Patuxent formation by several million gallons a day, and the water level rose rapidly to about 80 to 90 feet below the land surface by the end of 1945.

The general trends of the water levels in wells ending in the Patuxent formation in the Dundalk, Curtis Bay, and Fairfield districts are roughly similar, showing a general decline to about 100 feet below the land surface in 1940-42, after which the water levels rose in the Dundalk and Curtis Bay

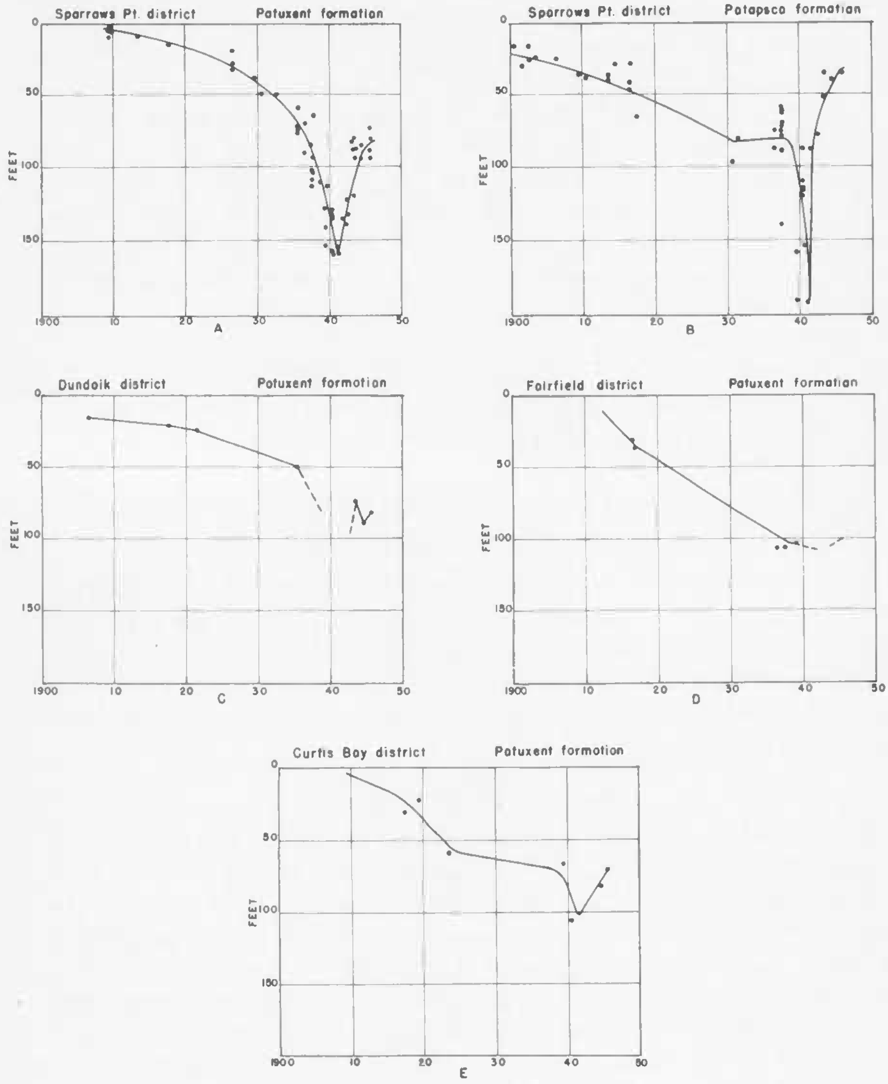


FIGURE 10. Graphs showing the general decline in artesian head, in feet below land surface, caused by pumping, 1900-45

districts to about 75 to 90 feet below the land surface. The water levels in the Fairfield district also rose after 1942, but by a much smaller amount. The rise in water levels in the wells ending in the Patuxent formation in all the industrial area after 1942 was caused chiefly by the reduction in pumping at a single plant, the Bethlehem Steel Co. in the Sparrows Point district

The trend of the artesian head of the Patapsco formation in the Sparrows Point district shows a gradual decline until about 1937-39, when the head was about 80 feet below the land surface. At about that time the Bethlehem Steel Co. increased its pumping and the artesian head declined rapidly, reaching a level of as much as 190 feet below the land surface in 1942. The pumpage was reduced considerably late in 1942 and the artesian head rose rapidly, reaching a level of about 30 to 50 feet below the land surface by the end of 1945.

No long-term records of water levels in wells ending in the Patapsco formation in the other industrial districts are available, but it is likely that the level at no time was more than 75 feet below the land surface.

WATER-LEVEL FLUCTUATIONS IN OBSERVATION WELLS BALTIMORE INDUSTRIAL AREA

It is essential to know as accurately as possible the exact trend of the water levels in the Baltimore industrial area; consequently observation wells were measured at frequent intervals, usually once a week or continuously by means of automatic water-level recorders. The water-level measurements are given in Table 17 and graphs of the water-level fluctuations in eight wells are shown in Figures 11 to 15.

Sparrows Point District

The water-level fluctuations in well Bal-Gf 6 (fig. 11), owned by the Bethlehem Steel Co., is typical of the changes in artesian head in the Patuxent formation near the center of pumping in the Sparrows Point district. The static water level in the well, which was about 151 feet below the land surface in 1941, rose about 60 feet during 1942. Since that time the trend of the water level has been essentially horizontal. The fluctuations during a year have a large amplitude, about 20 feet, owing to the changes in the rates of pumping of nearby wells.

Well Bal-Gf 177, at Bay Shore Park, also ends in the Patuxent formation and is in a locality of little pumping about 4 miles east of the center of pumping in the Sparrows Point district. Between July 24, 1943, and October 21, 1945 the water level in this well showed a net rise of 15.02 feet.

The fluctuations of the water level in well Bal-Gf 1, owned by the Bethlehem Steel Co., typify the changes in artesian head in the lower part of the Patapsco formation (fig. 12). The water level in this well rose about 55 feet

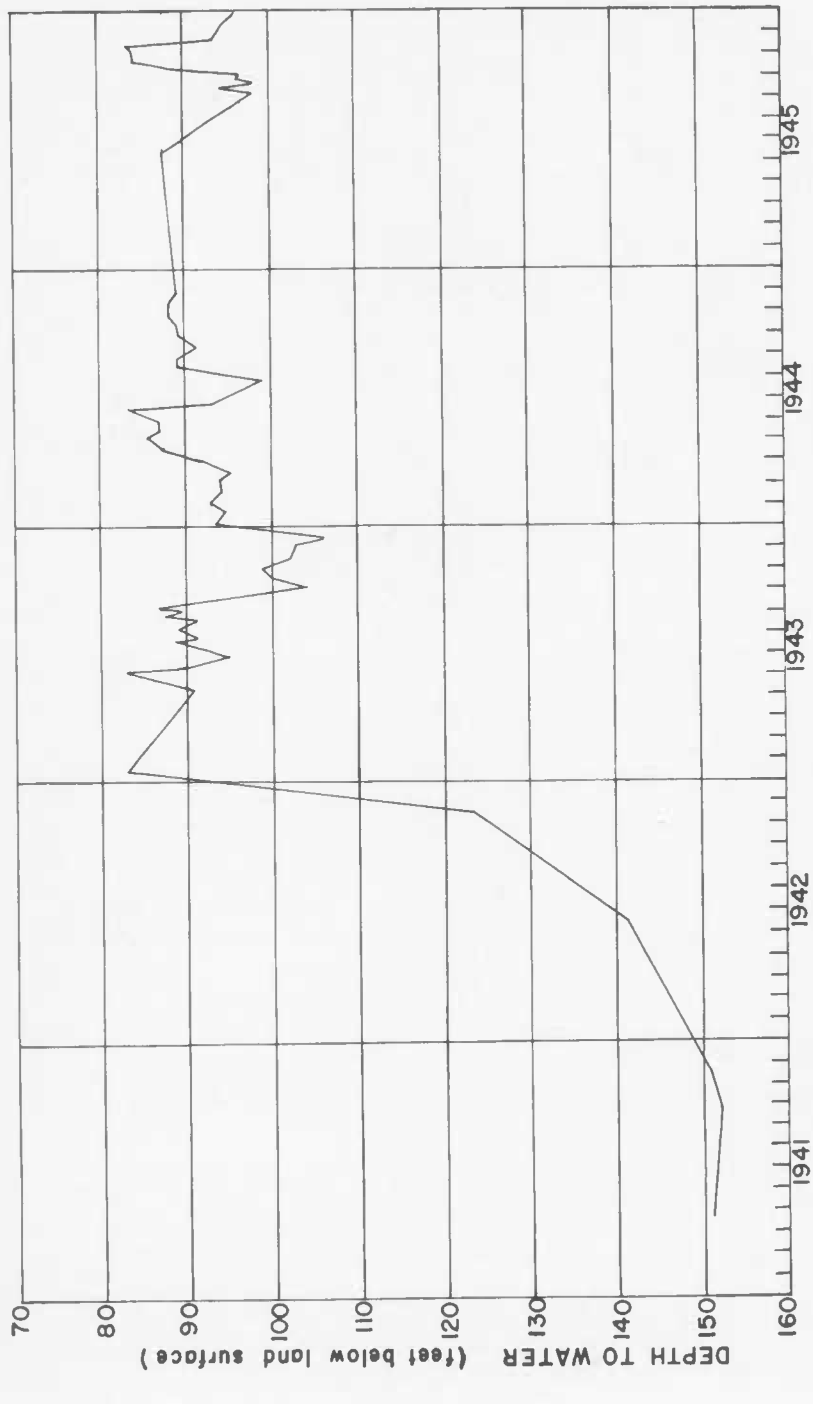


FIGURE 11. Graph showing fluctuations of water level in well Bal-Gf 6, penetrating the Patuxent formation in the Sparrows Point district

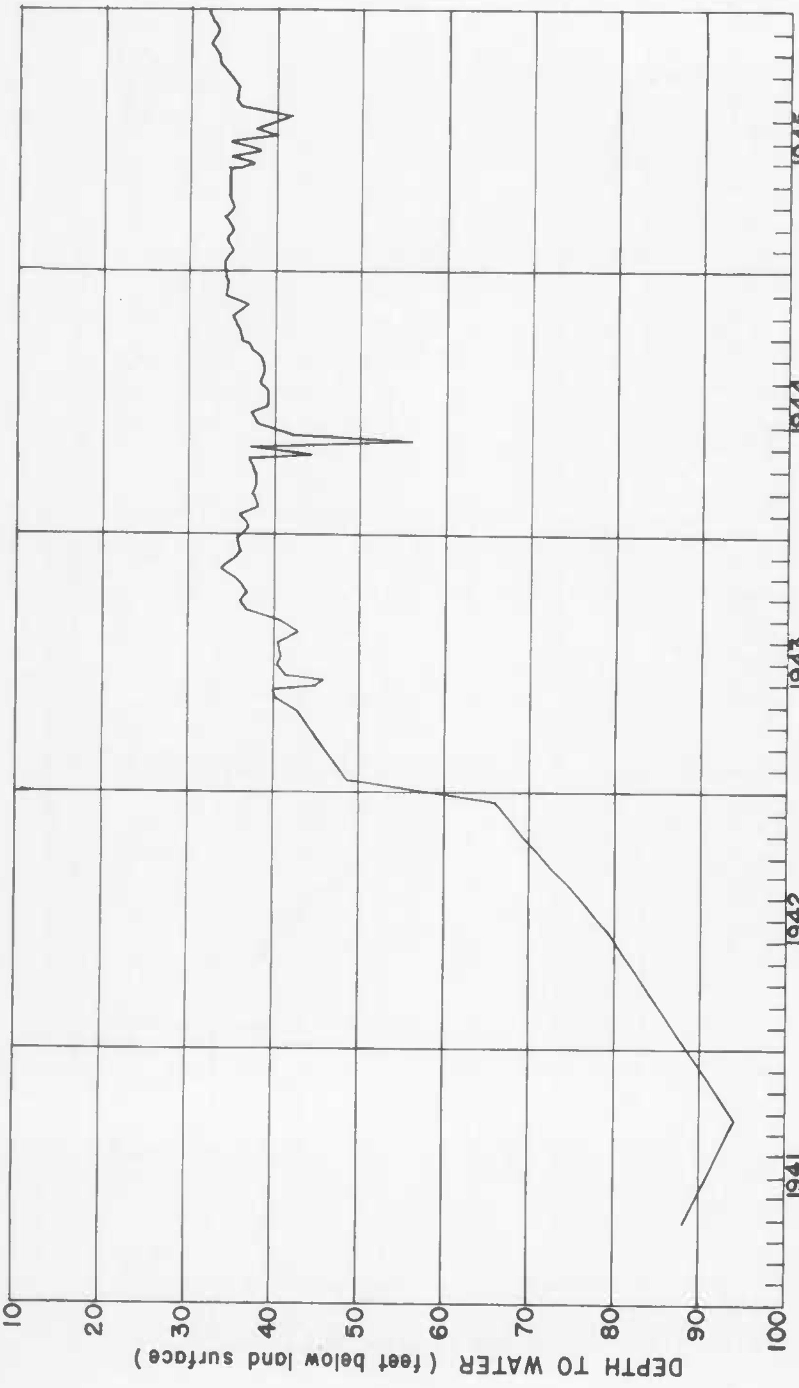


FIGURE 12. Graph showing fluctuations of water level in well Bal-Gf 1, penetrating the lower part of the Patapsco formation in the Sparrows Point district

during 1942-43, reaching a level of about 35 feet below the land surface near the end of 1943. During 1944-45 the trend of the water level was nearly horizontal, although there is a suggestion of a slightly upward trend during 1945. The minor fluctuations during 1944-45 were caused chiefly by changes in the rate of pumping from wells ending in the same aquifer at the Bethlehem Steel Co. plant.

Well Bal-Gf 183, which ends in the lower part of the Patapsco formation, was used as an observation well during the period June 12, 1944, to December 31, 1945. During that period the water level in the well, which is about 2 miles east of the center of heavy pumping in the district, showed a net rise of 8.39 feet. The major part of the rise probably was caused by the reduction of pumpage in 1942 at the Bethlehem Steel Co.

Fluctuations of artesian head in the upper part of the Patapsco formation in the Sparrows Point district are best shown by the record of water levels in well Bal-Gf 79, owned by the Bethlehem Steel Co. The water level in this well was 39.42 feet below the land surface on July 20, 1943, but it reached 28.60 on December 31, 1945, a net rise of 10.82 feet. The amplitude of the daily fluctuations in this well is much less than in most of the nearby wells which end in the lower part of the Patapsco formation and in the Patuxent formation.

Dundalk District

Water-level records of two wells, 2S5E-1 at Camp Holabird of the U. S. Army, and Bal-Gf 19, owned by Paul Jones and Co., Inc., are shown in Figure 13. The fluctuations in these wells probably represent the general trend of the artesian head in the Patuxent formation in the Dundalk district. The record of well 2S5E-1 shows that the water level declined from a recorded high of about 81 feet below the land surface in April 1943 to about 90 feet at the end of 1943. The trend of the water level is essentially horizontal through most of 1944 but late in that year it began an upward trend, reaching a level of about 85 feet below the land surface by the end of 1945. The record of water-level fluctuations in well Bal-Gf 19, measured in 1944 and 1945, shows a similar trend.

The cause of the downward trend in artesian head during 1943 and the upward trend during 1945 may be attributed largely to unrecorded changes in the rates of pumping at the Western Electric Co., Chemical and Pigment Co., or Federal Yeast Corp.

Fluctuations of the artesian head in the Patapsco formation are shown by the records of water-level fluctuations in wells 3S5E-3, 4, 6, 7, and 9, owned by the Federal Yeast Corp. The record of water-level fluctuations in well 3S5E-3 is the most complete and probably represents fairly well the changes of artesian head in the Patapsco formation in the Dundalk district. On May 10, 1943, the water level was 40.40 feet below the land surface and on December 28, 1945, it was 41.05 feet below the land surface, a net decline of 0.65 foot. The lowest water level reached during the period was on April 20, 1945, when the water level was 51.22 feet below the land surface. Doubtless this low level was caused by intermittent pumping from wells in the Patapsco formation at the Federal Yeast Corp.; however, the rate of pumping from these wells generally was relatively small. The trend of the water levels in these observation wells seemingly does not correspond with changes in artesian head in the Patapsco formation in other parts of the industrial area. Moreover, the depth to water level in the wells in the Patapsco formation in the Dundalk district is considerably lower than might be expected with the small amount of pumping from the Patapsco formation in this district.

Curtis Bay District

The changes of artesian head in the Patuxent formation in the Curtis Bay district are shown by the records of water levels in wells 5S3E-15 and 16 and

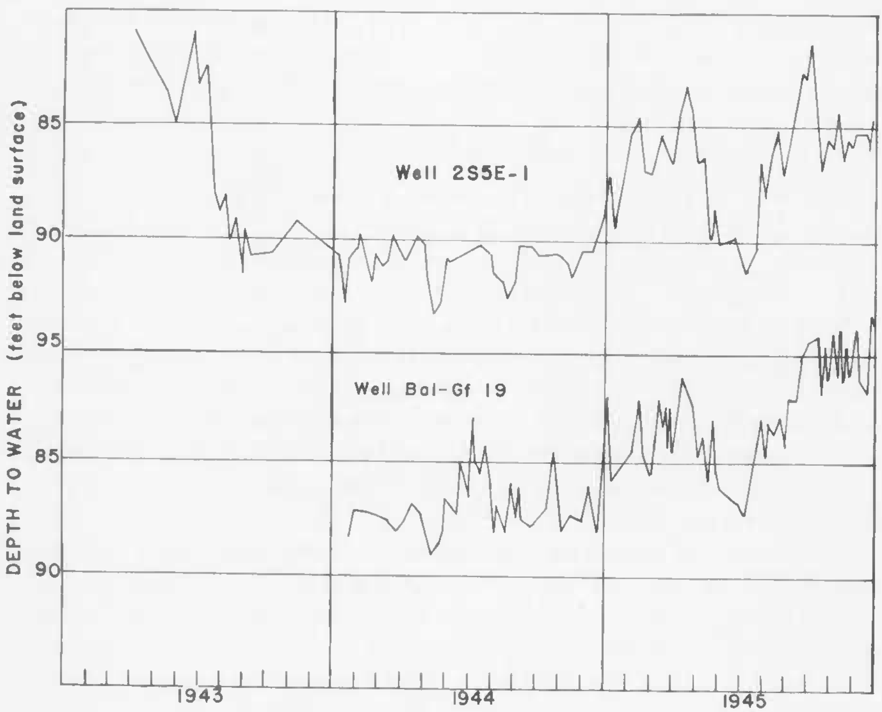


FIGURE 13. Graph showing fluctuations of water level in wells penetrating the Patuxent formation in the Dundalk district

6S2E-6, owned by the U. S. Industrial Chemical Co., Curtis Bay plant. The water-level fluctuations in well 6S2E-6 are shown in Figure 14.

Well 6S2E-4 was pumped from July to December 1943. During that time the water level in well 6S2E-6, the observation well, declined gradually. In December 1943 well 6S2E-4 was shut down for repairs, and by June 1944 the water level in the observation well rose about 25 feet. In September 1944, well 6S2E-4 was again pumped but at a higher rate than previously. This caused a rapid decline of about 45 feet in the observation well, after which the trend of the water level was slightly upward until October 1945, when well 6S2E-4 was again shut down, and the water level in the observation well rose about 45 feet.

Owing to the large amplitude of fluctuations in this observation well the general trend of the artesian head is not shown clearly. The net rise of 34.50 feet between July 6, 1943, and December 28, 1945, has little significance. However, the record of fluctuations between September 1944 and September 1945 suggests that the general trend of the water level was upward.

The Patapsco formation is an aquifer of relatively minor importance in the Curtis Bay district. No wells ending in this aquifer were available for periodic measurements of water level. Owing to the relatively low rate of pumping from this aquifer in the Curtis Bay district, the general trend of the artesian head probably has been approximately the same as in the Sparrows Point district, although the rate of rise or decline probably has been considerably less.

Fairfield District

The records of water-level fluctuations in wells 4S2E-4, owned by the Weyerhaeuser Timber Co., and 5S3E-15 and 16, owned by the U. S. Industrial Chemical Co., Fairfield plant, show the changes in artesian head in the Patuxent formation in the Fairfield district. During June 1945 the measured water level in well 4S2E-4 ranged from 60.40 to 65.35 feet below the land surface; however, during the remainder of 1945 the water level showed a general rise, reaching a high of 56.06 feet below the land surface on November 16, 1945. A part of this general rise probably was caused by the reduction of pumping at the Fairfield shipyards of the Bethlehem Steel Co.

Wells 5S3E-15 and 16 were measured periodically between January 26, 1945, and December 28, 1945. Although these wells end in the Patuxent formation they tap different water-bearing zones and, owing to the differences in the rates of pumping from each zone at the U. S. Industrial Chemical Co., Fairfield plant, the fluctuations of water level cannot be correlated in detail. The water levels in both wells are so affected by intermittent pumping from nearby wells that the resulting records do not indicate clearly the trend of the artesian head. All that can be concluded from the records of water levels in these

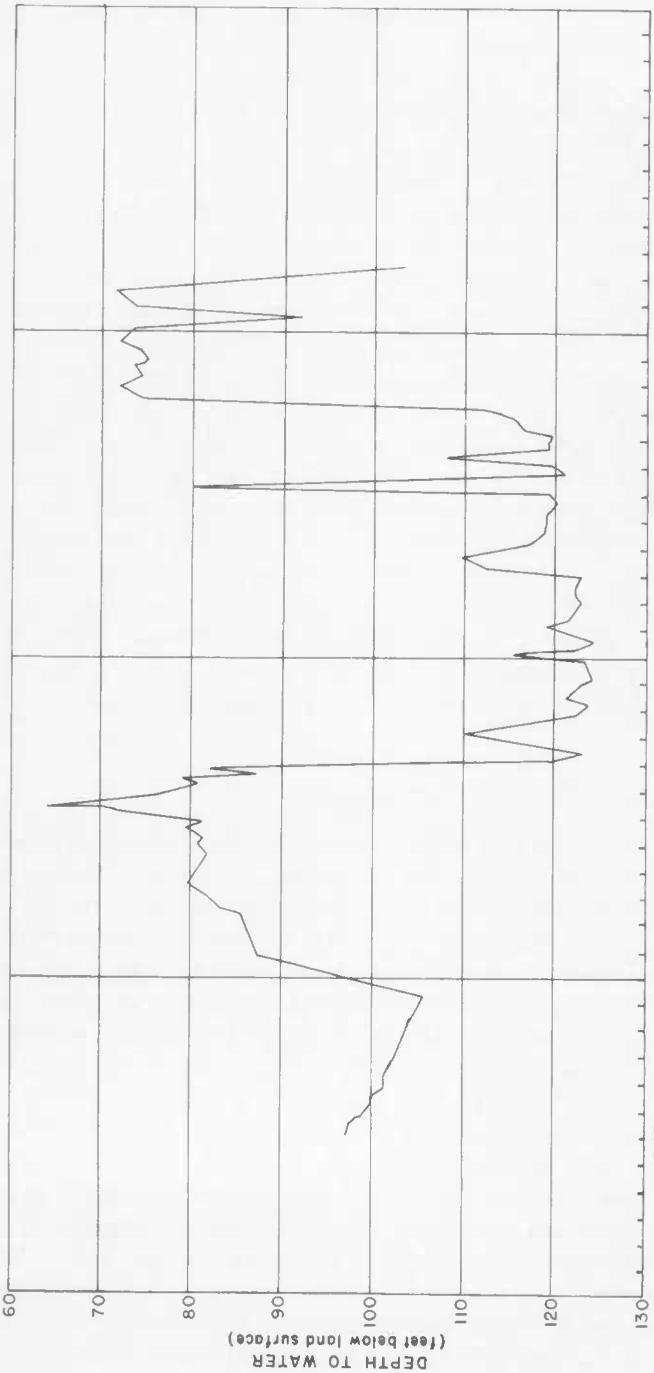


FIGURE 14. Graph showing fluctuations of water level in well 6S2E-6, penetrating the Patuxent formation in the Curtis Bay district

wells is that the artesian head in the Patuxent formation did not change greatly during 1945.

In that part of the area the Patapsco formation is of little or no importance as an aquifer; consequently, wells that could be used for measurement of water levels were not available.

Harbor District

The water-level fluctuations in well 2S1E-16, owned by the Buck Glass Co., and well 2S3E-11, owned by the J. S. Young Co., probably are indicative of the fluctuations of artesian head in the Patuxent formation in the Harbor district. Well 2S1E-16 is about 1,000 feet from the center of pumping at the Chesapeake Paperboard Co. As the rate of this pumping was changed periodically the fluctuations of water level in well 2S1E-16 have a large amplitude. However, the well was equipped with an automatic recorder, providing a continuous record of fluctuations from which the general trend of the water level could be determined. On April 5, 1944, the water level reached a low of 58.15 feet below the land surface and a high of 57.18 feet. At the end of the year, on December 31, 1944, the lowest water level was 48.29 feet below the land surface and the highest water level was 39.30 feet, showing that the artesian head rose about 10 to 15 feet during the period of measurement in 1944. The trend of the water level was essentially horizontal from January 1945 to May 1945. In May and June 1945 the water level declined about 10 feet, but from September through December 1945 rose about 3 feet. The general trend of the water level during the period of record from April 5, 1944, to December 31, 1945, showed a net rise of about 8 feet. The water-level fluctuations in this well seem to show the effects of seasonal changes in pumping in the Harbor district, for as a rule the water level was lower in the summer than in the winter.

The water-level fluctuations in well 2S3E-11 are shown in Figure 15. This graph shows that the trend of the water level was essentially horizontal during the last half of 1943 and the first half of 1944 but rose about 3.5 feet by the end of 1945.

Highlandtown District

The changes in artesian head in the Patuxent formation in the Highlandtown district are best shown by the records of water-level fluctuations in well 1S3E-12, owned by the Kimball Tyler Co., Inc., as this well is relatively far from the centers of heavy pumping in the district. The fluctuations of the water level in this well are shown in Figure 15.

During the period of measurement in 1944, March through December, the water level declined about 5 feet; during 1945, however, the water level rose about 2.5 feet, a rise that conforms with the trend of the water level in the Harbor district during this period.

Back River District

Periodic water-level measurements were made in well Bal-Ff 1, at the Baltimore Sewage Disposal Plant in the Back River district. The fluctuations of water level in this well, which ends in the Patuxent formation, are shown in Figure 15. The water level declined gradually from about 41 feet below the land surface in June 1943 to about 44 feet at the end of 1944. During 1945 there was a progressive rise to about 41.5 feet near the end of the year. The trend of the water level in this well during 1945 conforms reasonably well with the trend of the water levels in the Harbor and Highlandtown districts.

AREA OUTSIDE BALTIMORE INDUSTRIAL AREA

Relatively few periodic water-level measurements were made in wells outside the industrial districts in and near Baltimore, as few wells were available for observation; moreover, it was considered desirable to concentrate on the industrial districts where the ground-water problems were more serious.

Well Bal-Ef 19, owned by the United Clay Mines Corp., near Poplar, between U. S. Highway 40 and the Baltimore and Ohio Railroad, was measured periodically from November 18, 1944, to August 3, 1945. This well, which ends in the Patuxent formation near its outcrop, is not appreciably affected by pumping; and the fluctuations of water level show chiefly the changes in storage in the Patuxent formation in the outcrop area. These changes are significant as a large part of the water pumped from the Patuxent formation in the industrial districts is derived from the outcrop area of the formation. Consequently, if the movement of water down dip from the outcrop area exceeded the recharge from precipitation, the water-bearing material in the outcrop area would be progressively dewatered and the water level in this observation well would decline. On November 18, 1944, the water level was 60.05 feet below the land surface and on August 3, 1945, it was 59.29 feet, indicating that at this locality there was no appreciable change in storage of water in the aquifer.

Some owners of dug wells in the outcrop area of the Patuxent formation north of Baltimore were questioned to see if they had noticed any appreciable decrease in yield of the wells during the period 1935 to 1945. Only one of those questioned reported any noticeable decrease in yield, and it is probable that his well decreased in yield because of a faulty pump or because the well had caved. It seems reasonably certain that the pumping in the industrial districts in and near Baltimore has caused no marked lowering of the water table in the outcrop area of the Patuxent formation.

The water level in well 4N2W-9, owned by the Baltimore Country Club, in north Baltimore in the outcrop area of the pre-Cambrian crystalline rocks, was measured periodically from November 16, 1943, to December 28, 1945.

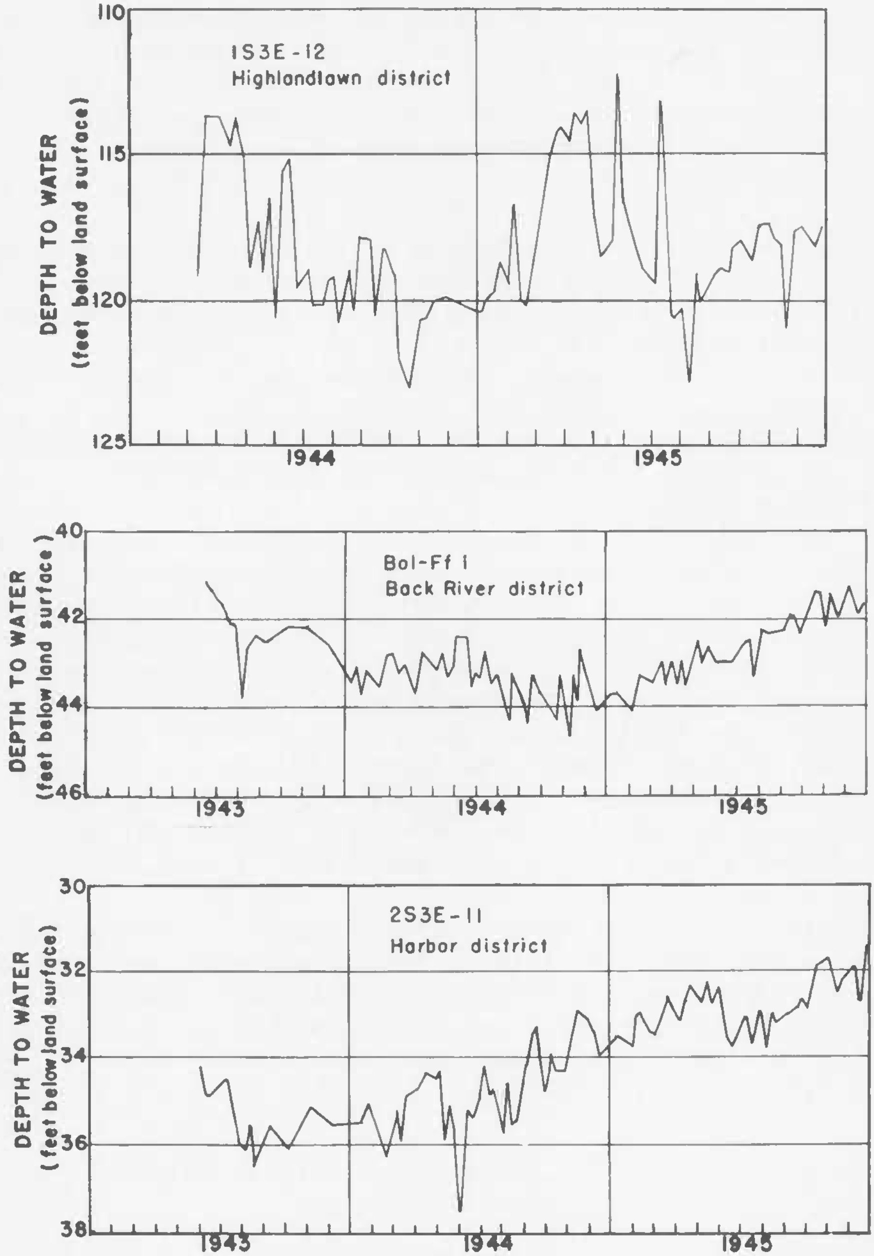


FIGURE 15. Graphs showing water-level fluctuations in wells in the Highlandtown, Back River, and Harbor districts

The fluctuations of water level in this well, which are caused chiefly by the effects of precipitation and transpiration, probably are typical of the general fluctuations of the water table in the crystalline-rock area where little or no water is pumped. The record of water-level fluctuations in this well showed a net rise of 2.37 feet during the period.

SUMMARY

Although the water levels in wells fluctuate from many different causes, the pumping of ground water, chiefly in the Baltimore industrial area, has been the principal factor in the changes of artesian head in the water-bearing formations in the Baltimore area.

Originally, before extensive ground-water development, the artesian head in the main aquifers, the Patuxent and Patapsco formations, was about 10 to 25 feet above sea level in a large part of the industrial area and in some places wells had a flow. With the progressive general development of ground-water supplies after about 1900, the artesian head in the Patuxent formation declined to as much as 160 feet below the land surface; and the artesian head in the Patapsco formation declined to as much as 190 feet below the land surface. In most parts of the area, however, the decline in head was much less. Late in 1942 the pumpage was decreased by about 13,000,000 gallons a day, in the Sparrows Point and Curtis Bay districts resulting in a progressive rise in artesian head. Water levels measured periodically during 1943 to 1945 in selected observation wells show that the trend of the water levels in most parts of the area has been upward or essentially horizontal. At the end of 1945, the water levels in wells in the Patuxent formation in most of the industrial area ranged from about 40 to 100 feet below the land surface, and in wells ending in the Patapsco formation, about 10 to 50 feet below the land surface.

Reports of the performance of wells and records of water levels in observation wells in the outcrop area of the Patuxent formation, the main aquifer in the Baltimore area, indicate no progressive decrease in storage of ground water in the outcrop area during the brief period of observation. Records are not available to show whether there was some decline during the earlier stages of ground-water development.

PIEZOMETRIC SURFACES IN THE BALTIMORE INDUSTRIAL AREA

"Piezometric surface" is a term used to denote the imaginary surface to which water will rise in artesian wells and the surface formed by the water table in the outcrop areas. Thus the terms piezometric surface and water table are here considered to be synonymous in the outcrop area, but the term piezometric surface alone is applicable in artesian areas where, it is generally supposed, there are only imaginary pressure surfaces, one for each aquifer. Such a sharp distinction is largely arbitrary, as there are no perfectly impervious rocks that can prevent completely the movement of water into or out of an artesian aquifer. For convenience of classification it is satisfactory to use these terms, provided it is realized that modification of the ordinary concepts may be necessary in analyzing some phases of the occurrence of ground water.

Prior to the development of ground water in the Baltimore area the configuration of the piezometric surfaces was controlled chiefly by the hydrologic characteristics of the aquifers and intervening confining beds, the topography of the outcrop areas, and the altitude of the land surface in the artesian areas. In the outcrop areas the piezometric surface or water table in general conformed to the shape of the land surface, being high in the interstream parts of the area and not far above stream level in the valleys.

In the outcrop area of the pre-Cambrian crystalline rocks the land surface is relatively uneven and incised by many streams; consequently the water table or piezometric surface is, under natural conditions, correspondingly uneven. In the outcrop area of most of the Coastal Plain sediments the land surface is flatter and the water table is more even. However, the western part of the outcrop of the Patuxent formation has been deeply dissected by streams and consequently the water table under natural conditions is very irregular and uneven.

In contrast to the water table in the outcrop areas, the piezometric surfaces in the artesian areas were, under natural conditions, relatively featureless. Although the exact shape of these surfaces before large ground-water developments is not known, it is reasonably certain that in general they sloped gently toward the southeast. However, this slope probably was not everywhere uniform, nor always southeast perpendicular to the trend of the outcrops of the aquifers. For example, the altitude of the outcrop of the Patuxent formation is generally higher in the area south of Baltimore than in the area to the north. Therefore it is likely that the piezometric surface of the Patuxent formation was higher in the southern part of the area and, consequently, there the slope of the piezometric surface may have been more nearly east, or even northeast, than southeast.

As most of the ground-water developments in the Baltimore area have been in artesian aquifers, the configuration of the water table in most parts of the outcrop areas has remained essentially unchanged. There are, however, some exceptions to this; for example, the pumping from the crystalline rocks in the North Baltimore district probably has formed a cone of depression, though a relatively small one. The pumping at the Eastern Stainless Steel Corp., in the Back River district, which is near the outcrop of the Patuxent formation, probably has depressed the water table in the area near the pumped wells. The pumpage in the Highlandtown and the Harbor districts, which also are relatively close to the outcrop of the Patuxent formation, probably has caused some local depressions to form in the water table; but, in relation to the total area of outcrop, these local changes in the configuration of the water table due to pumping are relatively small.

The changes produced by pumping in the piezometric surfaces of the artesian aquifers have been more pronounced and widespread. Plate 13 shows, by means of contours, the approximate configuration of the piezometric surface in the Patuxent formation in the Baltimore industrial area in 1945. The contours are based on measured depths to water level in wells adjusted to a sea-level datum.

A map of a piezometric surface constructed by this method has several serious limitations; consequently the contours at best are only an approximation of the artesian pressure. The movement of water in an artesian aquifer is three-dimensional, whereas this method of constructing a piezometric map arbitrarily assumes that the flow is two-dimensional (Hubbert, 1940, p. 910). In general this assumption may not cause serious errors, but, as the water-bearing material in the Patuxent formation is very irregular and wells generally are screened in only a part of the formation, the contours in Plate 13 probably are considerably in error, particularly in and near the centers of heavy pumpage. The adjustment of the pressure contours to fit a flow net in accordance with the Forchheimer graphical solution, as was done in the construction of the flow net shown in Plate 7, may partly correct these errors. However, as one of the valuable features of a piezometric map is that it shows the height to which water rises in existing wells, it seemed more desirable in Plate 13 to fit the pressure contours as closely as possible to the water levels measured in the wells rather than to adjust them to fit a flow net.

The lowest parts of the piezometric surface are in the centers of pumping in the industrial districts where pumping of water from the Patuxent formation has been greatest. The hydraulic gradient toward the center of the cone of depression in the Sparrows Point district appears to be much less than it is in the Curtis Bay and Fairfield districts, even though the rates of pumping are approximately the same. A part of this dissimilarity is caused by greater transmissibility in the Sparrows Point district, but a part also is caused by the relatively steep eastward gradient that existed west and southwest of the Curtis Bay and Fairfield districts, even before pumping began in the industrial area.

The lowest parts of the piezometric surface are in the centers of pumping in the Sparrows Point, Curtis Bay, and Fairfield districts; there the artesian head is more than 80 feet below sea level. The shallowest cones of depression are in the Back River, Highlandtown, and Harbor districts, where the artesian head is about 40 to 60 feet below sea level a short distance from the centers of pumping. With respect to the relative decline in head, these levels, however, are not directly comparable from one district to another, as the original artesian head was probably higher in the Back River, Highlandtown, and Harbor districts than in the Sparrows Point, Curtis Bay, and Fairfield districts.

The piezometric surface of the Patuxent formation shows the small extent and local nature of the large declines in artesian head caused by pumping. For example, although the artesian head near the centers of pumping in the Sparrows Point district was about 100 feet below sea level in 1945, the head was only 30 feet below sea level 3 miles east of the center of pumping. The artesian head also was about 100 feet below sea level, in 1945, near the center of pumping in the Curtis Bay district but was only 30 feet below sea level 1 mile west of the center of pumping.

The piezometric surface of the water in the lower part of the Patapsco formation is shown in Plate 14. As heavy pumping from this aquifer in the Baltimore industrial area is confined to the Sparrows Point district, there is only one large cone of depression. The artesian head near the center of the cone is about 40 feet below sea level, although at the pumped wells themselves the head is lower.

An interesting or unusual feature of the configuration of the piezometric surface in this aquifer is the failure of the 20-foot contour to close around the northwest side of the Sparrows Point district. The −10, 0, and +10 contours also seem to extend farther northwest than would be expected. The full explanation for this is not known, but it may be due to several factors. The original piezometric surface, before pumping began in the area, probably had a relatively steep northeastward slope in the area southwest of the Patapsco River estuary but was relatively flat in the area northeast of the river. This would have been caused by the relatively high altitude of the outcrop of the Patapsco formation southwest of the Patapsco River estuary. Thus the northeastward slope of the piezometric surface would cause the pressure contours to extend northwest, approximately parallel to the Patapsco River estuary, and even though pumping in the Sparrows Point district changed the configuration of the piezometric surface, some of the pressure contours would still extend northwesterly.

The measured low-water levels in wells in the Patapsco formation at the Federal Yeast Corp. plant in the Dundalk district suggest that the apparent northeastward extension of the cone of depression may be the result, in part, of the aquifer pinching out nearby. Such pinching out would cause the artesian head to be lower than it would be if the aquifer continued and cropped out.

It also is possible that the Arundel clay is absent in some parts of the Dundalk district, so that water can move from the lower part of the Patapsco formation into the Patuxent formation. However, the available well logs do

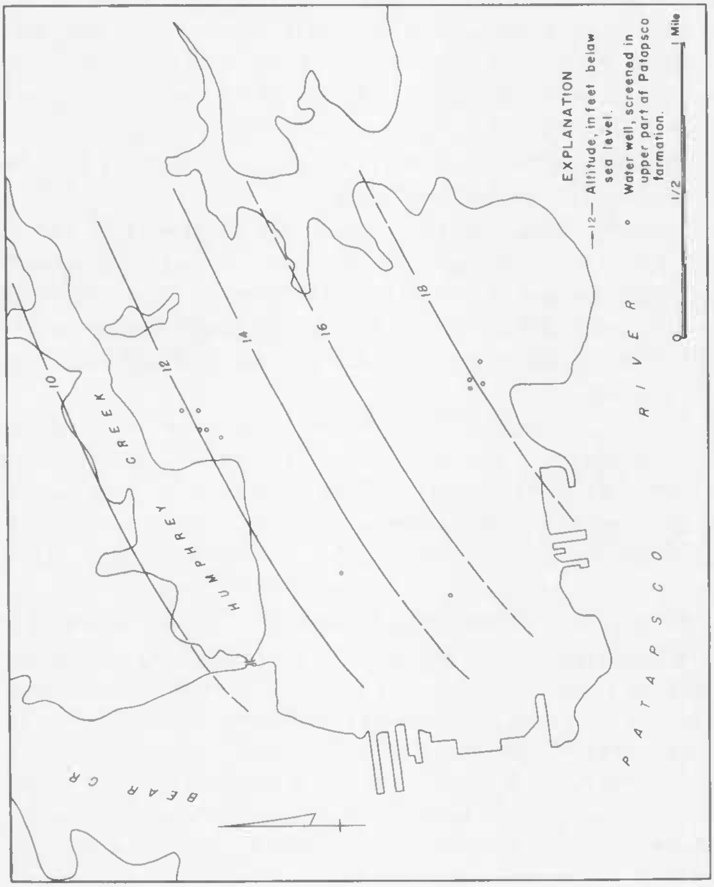


FIGURE 16. Map of Sparrows Point district showing approximate altitude of artesian head in upper part of Patapsco formation in 1945

not indicate that the Arundel clay is absent in this part of the area; moreover, chemical analyses of water from the Patuxent formation and water from the lower part of the Patapsco formation near the centers of pumping in the Dundalk district show that the waters are different. Thus it is likely that the Arundel clay prevents any large movement of water downward into the Patuxent formation, at least in and near the centers of pumping in this district.

The upper part of the Patapsco formation forms a separate aquifer in the Sparrows Point district but in other parts of the area is not clearly defined. However, as knowledge of this unit is important in an understanding of the occurrence of ground water in the Sparrows Point district, a map of its piezometric surface was constructed (fig. 16). Up to about 1942 this aquifer was pumped heavily in this district, but since that time there has been little or no pumping from it. Hence, the configuration of the piezometric surface is the result of the natural down-dip movement of water through the aquifer, and the withdrawals through downward leakage to the lower part of the Patapsco formation through wells and through natural openings in the clay bed that separates the two aquifers throughout most of the district.

In 1945 the piezometric surface ranged from about 10 to 20 feet below sea level and had a relatively uniform slope toward the southeast. The southeastward slope probably is caused chiefly by the opening in the clay bed in the southeastern part of the district (Pl. 6). Pumping from wells ending in the lower part of the Patapsco formation at the Bethlehem Steel Co. plant in the Sparrows Point district has established a hydraulic gradient from the upper part to the lower part of the Patapsco formation, thereby causing water in the upper part of the Patapsco formation to move southeastward across the district, then downward to the lower part of the formation, and then northwestward to the pumped wells.

MOVEMENT OF GROUND WATER

Ground water moves from points of high to points of low potential—in other words, from points at which the artesian head or water table is high to points at which it is low; it moves in the direction of the steepest hydraulic gradient. In broad view, the movement of water in the unconsolidated sediments in the Baltimore area is simple. The water moves from the outcrop areas, where the water table is at a relatively high altitude, down the dip to the southeast where because of loss of head from friction the hydrostatic head is progressively lower. In detail, however, the movement of water is very complex, owing to the inhomogeneity of the rocks, the differences in transmissibility and porosity, the leakage through confining beds, and because the movement is three-dimensional.

In the outcrop areas of the water-bearing formations the general pattern of the movement is controlled largely by the configuration of the land surface. Most of the water moves slowly from the interstream areas to the streams where it is discharged; but some water moves down the dip into the artesian parts of the aquifers. The general pattern of flow of ground water adjacent to a stream in the outcrop area is shown in Figure 17. Although this pattern of flow is attained approximately in the outcrop areas of the unconsolidated sediments, it probably is only vaguely similar to the pattern of flow in the crystalline-rock area where the openings in the rocks may be widely spaced.

As the outcrops of the water-bearing formations in the Baltimore area are incised by numerous streams, the direction of movement of ground water has little uniformity. The direction of ground-water movement in the artesian parts of the aquifers, however, is more uniform. The general pattern of ground-water flow before pumping began was greatly different from the present pattern caused by the pumping of large quantities of ground water. Figure 18 shows schematically the movement of ground water under two sets of conditions that existed in different places in the artesian aquifers in the Baltimore area before development of ground-water supplies began. Figure 18 A shows the general pattern of ground-water movement in an artesian aquifer in which the artesian head is higher than the water table. Under

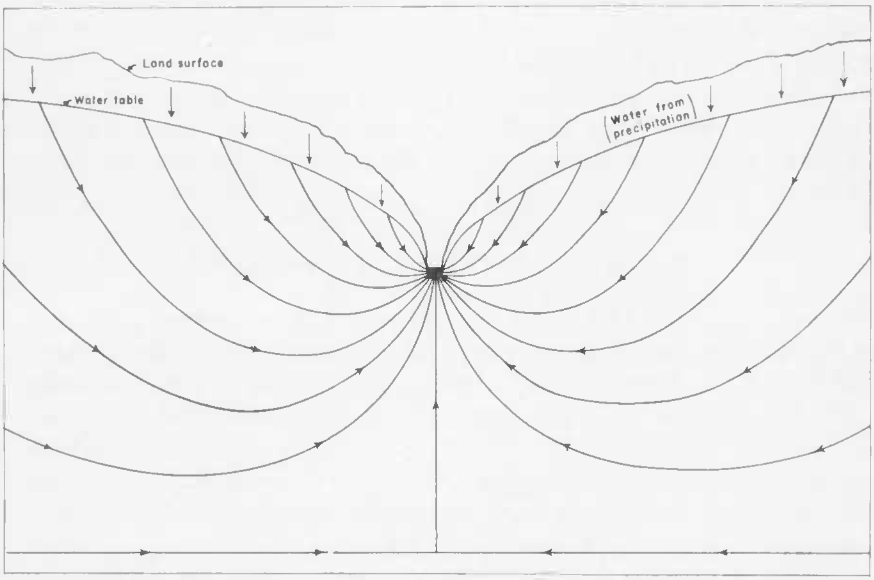


FIGURE 17. Schematic cross section showing the general pattern of ground-water flow into a stream

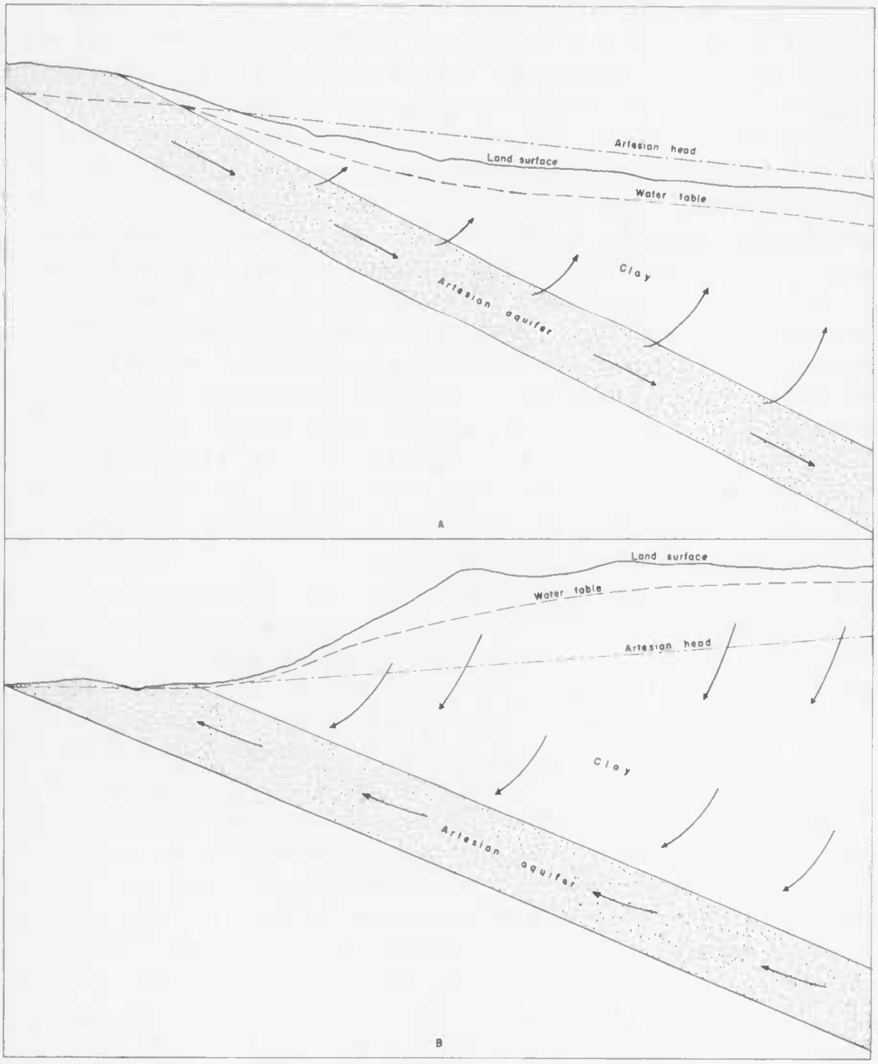


FIGURE 18. Schematic diagrams showing general direction of movement of groundwater in an artesian aquifer: A, artesian head higher than water table; B, artesian head lower than water table

these conditions water moves slowly down the dip from the outcrop area, then upward through the overlying confining beds to the saturated material near the land surface, and then moves either upward into the atmosphere through evaporation or transpiration or laterally to surface streams where it is discharged. Figure 18 B shows the general pattern of movement in an artesian aquifer in which the artesian head is lower than the water table. Under these conditions ground-water movement is practically the reverse of that shown in Figure 18 A. The higher position of the water table causes water to move downward through the confining beds into the artesian aquifer, then up dip to the outcrop area where it is discharged into surface streams or into the atmosphere by evaporation and transpiration. The schematic diagrams shown in Figure 18 oversimplify the actual patterns of flow that existed in the area, because the parts of the area in which the artesian head was higher than the water table were chiefly in the vicinity of the estuaries, whereas the parts of the area in which the artesian head was lower than the water table were chiefly in the land areas between the estuaries. Consequently, the areal distribution of the two types of conditions was irregular, and the patterns of flow in few places were as simple as shown in Figure 18. However, the upward movement of water from the artesian aquifers into the salt-water estuaries was the principal factor that prevented salt water from moving downward and contaminating the artesian aquifers.

The pumping of large quantities of ground water, particularly in the Baltimore industrial area, has changed considerably the direction and rate of ground-water movement. The lowering of the artesian head that has accompanied the withdrawal of ground water has established a hydraulic gradient from the outcrop areas of the artesian aquifers down the dip to the centers of pumping. Consequently at the present time the pattern of flow in the artesian aquifers is a slow movement of ground water down the dip from the beveled edges or outcrop areas of the artesian aquifers. In a large part of the Baltimore industrial area the lowering of the artesian head also has caused an increase in the rate of movement downward through the overlying confining beds and in the parts of the area where water moved upward from the artesian aquifers the pumping has reduced the movement or even reversed it. However, the quantity of water per unit area moving down the dip from the outcrop areas of the artesian aquifers far exceeds the movement through the confining beds; consequently, for most ground-water problems the general movement of water through the confining beds is not important.

As the steepest hydraulic gradient would be approximately perpendicular to the contours of equal artesian head shown on the maps, the piezometric maps show the approximate direction of the movement of ground water in the aquifers. The direction of movement may differ from that inferred from the piezometric contours because the motion of ground water is three-dimensional whereas the map assumes it to be two-dimensional. Moreover, the direction of movement is influenced also by differences in transmissibility. For example, if the transmissibility of the sediments is higher in a certain direction, as it may be in the Patuxent formation in the Baltimore industrial area, a greater proportion of water would move in that direction than would be indicated by the piezometric contours. If the effect of these limitations is taken into account, the piezometric maps serve well to indicate the general direction of ground-water movement.

The piezometric map of the Patuxent formation (Pl. 13) shows the centers of cones of depression, produced by pumping, toward which water is moving; but the direction of the movement of the water in the Patuxent formation can be seen more readily from the flow-net map (Pl. 7). The flow lines show that a large part of the water pumped from the Patuxent formation in the Back River, Highlandtown, and Harbor districts has moved directly southeast from the outcrop of the formation, whereas most of the water pumped from the Patuxent formation in the Sparrows Point and Curtis Bay-Fairfield districts has moved northeast and southwest approximately along the strike of the formation in the vicinity of the Baltimore industrial area. The relatively low transmissibility of the Patuxent formation along its outcrop has caused the cone of depression, produced by pumping in the Baltimore industrial area, to extend farther northeast and southwest of Baltimore than it would if the transmissibility at the outcrop were higher. This elongation of the cone of depression parallel to the outcrop causes water to move to the centers of pumping from greater distances. Although no positive data are available, it is possible that water may move to the centers of pumping from distances as much as 20 to 40 miles southwest and northeast of Baltimore.

The rate of movement of water in the artesian aquifers is exceedingly slow. This can be shown by computing the approximate rate of movement in the Dundalk district where the transmissibility of the Patuxent formation is highest. The approximate velocity of ground water moving through sediments may be computed by the following equation:

$$V = \frac{Pi}{p}$$

where

$V =$ velocity in feet per day

$P =$ permeability in cubic feet per day per square foot

$i =$ hydraulic gradient expressed as decimal fraction

$p =$ porosity expressed as decimal fraction

According to the flow-net analysis the coefficient of transmissibility of the Patuxent formation in the Dundalk district is 70,000; and the available well logs show that the average thickness of permeable water-bearing material is about 70 feet. The coefficient of permeability is therefore $\frac{70,000}{70}$ or 1,000 gallons a day per square foot which is equal to 133.7 cubic feet per day per square foot. The porosity of the water-bearing material in the Patuxent formation is not known, but is estimated to be about 40 percent or, expressed as a decimal, 0.40. With a hydraulic gradient of 100 percent, or unity, the velocity would be $\frac{133.7 \times 1}{0.40}$ or 334 feet per day. Obviously a hydraulic gradient of 100 percent would occur only within a few feet of the pumping wells where the cone of depression slopes steeply. At a distance of about 1 mile northwest of the center of pumping in the Dundalk district the hydraulic gradient is about 30 feet per mile and with this gradient the velocity would be 1.9 feet per day or about 700 feet per year. At this rate, it would take from 20 to 25 years for water to move from the Harbor district to the center of pumping in the Dundalk district, a distance of about 3 miles.

Northeast of the industrial districts the hydraulic gradient decreases appreciably and beyond a distance of about 10 miles probably is no more than 5 feet per mile. With this gradient, and with the coefficient of permeability and porosity used in computing the velocity in the Dundalk district, the velocity of the water would be about 0.3 foot per day or about 110 feet per year. Water in the Patuxent formation may move to the Baltimore industrial area from a distance of as much as 40 miles; consequently, at a velocity of 110 feet per year, the time required for the water to move 40 miles would be nearly 1,900 years. In other words, a part of the water pumped from the Patuxent formation at the present time (1945) may have entered the aquifer as long ago as the 1st century.

The general direction of movement of water in the lower part of the Patapsco formation is indicated by the piezometric map of this aquifer (Pl. 14). As most of the pumping from the water-bearing formation is now centered in the Sparrows Point district, in general the water moves toward that district. The piezometric contours show that relatively little water moves directly down the dip from the northwest, the direction from which it normally would be expected to move. The reason for this is not known but, as explained previously, the water-bearing material may pinch out in the vicinity of the Canton district, thereby preventing water from entering the aquifer from that direction.

Figure 16, a piezometric map of the upper part of the Patapsco formation in the Sparrows Point district, shows the general direction of the movement of water in this aquifer. The piezometric contours indicate that water moves rather uniformly southeast across the district. As there was practically no pumping from this aquifer during 1945, the water is not diverted to any points of withdrawal. The movement appears to be controlled chiefly by openings in the confining bed that separates the lower and upper parts of the Patapsco formation in a large part of the district. The openings probably are south and southeast of the district, permitting water in the upper part of the formation to move downward into the lower part.

RECHARGE

Several factors affect the rate of recharge. The quantity of water that falls as precipitation is important; but, in the Baltimore area where the average annual precipitation is about 42 inches, and prolonged dry periods are uncommon, the rate of recharge is more dependent on other factors, such as the permeability of the water-bearing material. With respect to permeability, the conditions for recharge are more favorable in the unconsolidated sediments than in the less permeable crystalline rocks. The configuration of the land surface also has some effect in limiting the recharge; on steep slopes, such as those in the crystalline-rock area, water from precipitation runs off more rapidly than on the flatter land surface formed by the unconsolidated sediments. The density and type of vegetation control the amount of water transpired from the soil zone during the growing season and thus some water is prevented from reaching the water table. The areal extent of the outcrops of the water-bearing formations is important, for more water may enter a formation if its area of intake is large than if it is small. Under natural conditions, however, the outcrop of a formation may function, in some areas, as a discharge area, the recharge taking place through the overlying confining beds in the artesian part of the aquifer. Even when the artesian part of an aquifer is recharged by water transmitted from its outcrop area, the rate of recharge in the outcrop area, under natural conditions, may be limited by the rate at which water is discharged naturally through the confining beds overlying the artesian part of the aquifer.

Thus in the Baltimore area, where the amount of precipitation is not as important a limiting factor as it is in drier areas, the rate of recharge in the outcrop area under natural conditions is affected greatly by (1) the permeability and thickness of the confining beds in the artesian part of the aquifer, (2) the hydraulic gradient between the artesian aquifer and the water table at or near the land surface, and (3) the size of the area of confining beds through which water is discharged. In accordance with the principle (Ghyben-Herzberg) governing the occurrence of fresh water in aquifers that are hydrologically connected with the sea, the size of the area through which water discharges, under natural conditions in the artesian aquifers, is somewhat dependent on the height of the water table above sea level. Therefore, the rate of recharge to the artesian aquifers is, in turn, proportional to the height of the water table above sea level. Under hypothetical conditions where the outcrop forms a perfectly level surface, the recharge would equal the amount of water that could be transmitted down the dip and through the relatively impervious confining beds. Under these conditions the rate of recharge generally would be small and a large part of the water from precipitation would be rejected. However, where the outcrop areas are incised by effluent streams, as they are in the Baltimore area, ground water would be discharged into them and accordingly would permit water from precipitation to enter the aquifer at a higher rate. The increase in recharge caused by the presence of effluent streams is not important so far as the artesian parts of the aquifers are concerned, for in a sense it is merely an underground form of rejected recharge. That it occurs shows clearly, however, that the potential recharge in the Baltimore area far exceeds the quantity of water now being transmitted down the dip to the localities or areas of discharge. That the potential recharge is high might be expected, for the average annual precipitation is high and in general the land surface formed by the porous and permeable unconsolidated sediments is relatively flat. In Baltimore, however, buildings and paved streets form an impervious covering that decreases the rate of infiltration from precipitation. It is difficult to estimate their effect on the recharge; but, with respect to the recharge in the entire outcrop area, it probably is insignificant. Nevertheless, reduction of recharge in the vicinity of Baltimore caused by buildings and streets may have decreased slightly the availability of water in the Harbor, Canton, and Highlandtown districts.

The pumping of ground water may lower the water table sufficiently to establish a gradient from a stream or other bodies of surface water to the pumped wells, thereby increasing the recharge to the aquifers. For example, the pumpage of about 1,200,000 gallons a day from the Pleistocene deposits at the Calvert Distilling Co., near St. Denis, is derived largely by induced recharge from the Patapsco River. The water table in the Patuxent formation in the Harbor and Canton districts is lower than the water level in the adjacent Patapsco River estuary, so that recharge is induced, but here it is not desirable because the water in the estuary is brackish. Pumping from the Patapsco formation in the Baltimore industrial area also induces recharge of brackish water from the Patapsco River estuary.

In summation, although practically all the ground water in the Baltimore area is derived from precipitation the potential rate of recharge is so high that it is not an important limiting factor in the quantity of ground water that can be developed.

CHEMICAL CHARACTER OF THE GROUND WATER

All the mineral components in rocks are soluble in water to some extent; consequently, ground water in passing through the rocks becomes mineralized.

The character and degree of mineralization depend on many complex factors but in general are controlled by the type of minerals in the rocks and the solvent power of the water, which generally varies in accordance with the amount of dissolved carbon dioxide and organic acids it contains. For the most part the minerals in the rocks in the Baltimore area are rather insoluble so that the ground water, where it is not contaminated by salt water, generally contains a relatively low content of mineral matter. Nevertheless, even when the water contains very small quantities of some mineral constituents, treatment may be required before the water can be used in certain industrial processes; hence it is generally desirable to know accurately the quantity of the various mineral constituents in the water. Moreover, in the Baltimore area, the large ground-water developments have caused changes in chemical character of the water in some parts of the aquifers, and many chemical analyses are required for an understanding of the nature and extent of these changes. In the following discussion "contamination" refers to undesirable changes in mineral content and not to bacterial pollution.

Chemical analyses of 129 samples of water from 112 wells were made by the Water Resources Laboratory of the Geological Survey; these analyses, with analyses obtained from other sources, are given in Table 13.

CHEMICAL CHARACTER OF UNCONTAMINATED GROUND WATER

Although large parts of the Baltimore industrial area now yield ground water that has become highly mineralized, through contamination induced by pumping, it is desirable first to summarize the chemical character of the ground water where it is uncontaminated, as this affords a basis for comparison.

PRE-CAMBRIAN CRYSTALLINE ROCKS

Water from twelve wells ending in the crystalline rocks was analyzed during the investigation, and only three of these wells appear to yield uncontaminated water. These are wells Bal-Fc 1, Har-Dc 1, and How-Cg 1. Three analyses are not sufficient to show accurately the native chemical character of the water from the crystalline rocks, but as most of the ground water in the Baltimore area is derived from the unconsolidated sediments it seemed desirable to restrict the number of analyses of water from crystalline-rock wells so that a larger number of analyses of water could be made for wells ending in the unconsolidated sediments. The three analyses, however, indicate the order of magnitude of mineralization, as field observations and information from people using wells ending in the crystalline rocks indicate no wider range in chemical character than shown by the three anlayses. The range in some of the mineral constituents in parts per million, shown by the three analyses is:

TABLE 13
Chemical Analyses of Water from Wells

Pre-Cambrian Crystalline Rocks

Well	Date of collection	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium and potassium (Na+K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Dissolved solids	Total hardness as $CaCO_3$	Total acid	Hydrogen-ion concentration (pH)	Specific conductance (Kx10[5] at 25°C.)	Analyst
1S3E-1	Feb. 4, 1943	-	-	-	-	-	-	152	44	91	.0	-	-	44	-	8.8	64	A
1S3E-15	1913	-	1.8	-	-	-	-	-	-	11	2.5	-	-	26	-	-	-	J
1S3E-18	1913	-	.60	-	-	-	-	-	4.9	5.5	2.5	-	-	27	-	-	-	J
1S3E-21	1913	-	.20	-	-	-	-	-	-	10	5.0	-	-	27	-	-	-	J
1S3E-22	1913	-	.40	-	-	-	-	-	-	10	.5	-	-	27	-	-	-	J
2S1E-78	May 29, 1944	-	2.6	-	-	-	-	108	230	1,590	-	-	-	480	-	7.7	539	A
2S3E-6	1913	-	.45	-	-	-	-	-	5.9	8	1.6	-	-	23	-	-	-	J
2S3E-6	May 25, 1943	-	78	-	-	-	0	134	55	310	-	.5	-	153	-	8.0	128	A
2S3E-6	Apr. 5, 1944	18	.38	58	14	201	-	130	52	340	.2	-	776	202	-	6.9	141	A
2S3E-7	May 25, 1943	-	-	-	-	-	-	2.0	65	850	-	.3	-	372	-	5.1	286	A
2S3E-7	Apr. 5, 1944	5.8	.31	64	48	366	-	5.0	62	765	7.5	-	1,430	357	-	5.9	265	A
2S3W-4	July 22, 1937	-	-	-	-	-	-	-	-	23	-	-	182	-	-	7.8	-	B
2S3W-4	Feb. 19, 1938	-	Trace	-	-	-	-	-	-	-	-	-	81	-	-	-	-	B
2S3W-4	Sept. 16, 1943	-	21	-	-	-	3.0	88	20	45	.0	-	-	-	-	8.3	33	A
3S1W-2	Feb. 8, 1944	-	-	-	-	-	7.9	84	50	355	-	-	-	204	-	8.0	139	A
3S1W-3	Feb. 8, 1944	-	-	-	-	-	5.9	8.0	250	1,650	-	-	-	765	-	8.4	548	A
1N1E-1	1913	-	.35	-	-	-	-	-	-	176	2.5	-	-	122	-	-	-	J
AA-Bb 7	Aug. 17, 1927	-	.1	-	-	-	-	-	-	4.6	.0	-	-	56	-	-	-	C
Bal-Fc 1	Oct. 19, 1943	-	-	-	-	-	-	4.0	1	12	25	-	-	30	-	5.2	11	A
Har-Dc 1	Aug. 9, 1944	-	8.0	-	-	-	12	144	6	4	.0	-	-	123	-	8.2	29	A
How-Cf 1	-	-	-	-	-	-	-	-	-	-	-	-	-	102	-	7.0	-	J
How-Cg 1	Apr. 26, 1944	-	1.0	-	-	-	7.9	112	20	5	.1	-	-	105	-	8.5	26	A

Patuxent Formation

Well	Date of collection	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium and potassium (Na+K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Dissolved solids	Total hardness as $CaCO_3$	Total acid	Hydrogen-ion concentration (pH)	Specific conductance (Kx10[5] at 25°C.)	Analyst
1S3E-2	June 5, 1945	9.7	5.8	12	7.5	43	0	6.0	34	66	27	.1	212	61	-	4.8	38.7	A
1S3E-4	Apr. 3, 1943	-	-	-	-	-	-	9.0	5	22	36	-	-	18	-	5.4	-	A

[a] Total acidity as HCl. [b] Total acidity as H_2SO_4. [c] Well also screened in Patapsco formation.

TABLE 13 — *Continued*
Patuxent Formation — *Continued*

Well	Date of collection	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium and potassium (Na+K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Dissolved solids	Total hardness as $CaCO_3$	Total acid	Hydrogen-ion concentration (pH)	Specific conductance (K x 10^5 at 25°C.)	Analyst
1S3E-5	Sept. 10, 1943	-	-	-	-	-	0	0	13	32	32	-	-	51	[b]2.4	4.7	23.2	A
1S3E-6	Sept. 20, 1943	-	-	-	-	-	-	7.0	1	12	16	-	-	27	-	5.4	9.5	A
1S3E-7	Sept. 20, 1943	-	-	-	-	-	-	6.0	1	9	15	-	-	24	-	7.1	7.9	A
1S3E-9	1913	-	.4	-	-	-	-	-	10	5.5	.6	-	-	171	-	-	-	J
1S3E-20	1913	-	.05	-	-	-	-	-	3.2	2.5	.30	-	-	16	-	-	-	J
1S4E-1	Nov. 24, 1942	55	Trace	-	-	-	-	-	148	-	-	-	-	98	9	3.3	-	E
1S4E-1	Mar. 11, 1944	8.6	.16	14	7.4	31	0	0	30	70	21	-	196	65	[b]13	4.2	38.8	A
1S4E-2	Nov. 24, 1942	22	0	-	-	-	-	-	4	-	-	-	-	32	-	4.9	-	E
1S4E-2	Apr. 1, 1943	-	-	-	-	-	-	-	28	24	20	.0	-	-	-	6.7	20.8	A
1S4E-2	Mar. 11, 1944	8.7	.12	11	5.2	12	-	6.0	28	20	17	-	114	-	-	5.1	18.9	A
1S4E-9	1913	-	.35	-	-	-	-	-	-	4	1.4	-	-	15	-	-	-	J
1S4E-18	1913	-	13	-	-	-	-	-	1	3	.8	-	-	-	-	-	-	J
1S4E-19	Sept. 21, 1944	-	10	11	-	-	-	-	-	-	-	-	134	44	-	5.9	-	D
2S1E-1	July 1, 1943	-	-	-	-	-	-	190	130	2,250	.2	-	-	862	-	6.6	704	A
2S1E-2	July 1, 1943	-	-	-	-	-	-	152	150	1,260	11	-	-	622	-	6.2	440	A
2S1E-4	Sept. 21, 1943	-	11	-	-	-	26	301	480	5,350	-	-	-	1,770	-	8.4	1,590	A
2S1E-5	Sept. 21, 1943	-	106	-	-	-	-	16	170	1,990	-	-	-	690.	-	7.6	627	A
2S2E-1	Apr. 1942	-	-	-	-	-	-	-	-	3,922	-	-	7,624	958	-	-	-	D
2S2E-1	July 2, 1943	-	1.3	-	-	-	-	486	380	4,125	1.2	-	-	1,530	-	6.8	1,294	A
2S3E-1	May 25, 1933	19	11	65	31	-	-	-	310	370	Trace	-	-	-	-	4.8	-	D
2S3E-2	Aug. 1, 1933	-	-	-	29	-	-	-	-	284	-	-	-	287	-	-	-	D
2S3E-5	Aug. 1, 1933	-	-	-	80	-	-	-	-	324	-	-	-	283	-	-	-	D
2S3E-8	1913	-	.20	-	-	-	-	-	2	20	3.0	-	-	20	-	-	-	J
2S3E-8	May 25, 1943	-	-	-	-	-	0	52	60.	860	-	.0	-	366	-	5.5	292	A
2S3E-17	1941	-	-	-	-	-	-	-	-	784	-	-	-	406	-	5.4	-	J
2S3E-36	1913	-	.25	-	-	-	-	-	-	14	2.5	-	-	20	-	-	-	J
2S4E-1	May 14, 1943	-	-	-	-	-	-	6.0	28	36	5.8	.0	-	45	-	5.9	20.9	A
2S4E-2	Nov. 24, 1942	105	.00	-	-	-	-	-	264	-	-	-	-	116	11	3.71	-	E
2S4E-2	Apr. 1, 1943	-	7.0	-	-	-	-	-	409	150	22	-	-	285	-	3.6	130	A
2S4E-2	Mar. 11, 1944	23	7.5	52	28	116	0	0	399	170	20	-	875	245	[b]161	3.6	132	A
3S1E-1	July 1, 1943	-	5.2	-	-	-	-	258	130	3,730	.0	-	-	1,455	-	6.4	1,132	A
3S1E-1	Apr. 5, 1944	-	20	122	219	1,770	-	25	221	3,400	-	-	6,040	1,200	-	6.1	1,060	A
3S1E-2	Sept. 17, 1939	-	-	114	137	1,360	-	276	103	2,431	-	-	-	847	-	6.5	-	J
3S3E-1	May 4, 1943	-	-	-	-	-	-	14	8	425	2.2	-	-	195	-	6.8	144	A
3S3E-2	May 4, 1943	-	-	-	-	-	-	12	22	890	-	.0	-	382	-	6.9	282	A
3S3E-2	Apr. 5, 1944	9.4	.14	74	53	475	-	14	26	990	.5	-	1,680	402	-	5.3	317	A
3S4E-1	May 28, 1943	-	-	-	-	-	0	8.0	1	2	.8	.0	-	7.5	-	6.8	2.4	A
3S4E-2	May 10, 1943	-	-	-	-	-	-	9.0	2	65	.1	.1	-	45	-	6.0	29.4	A
3S5E-1	May 4, 1943	-	-	-	-	-	-	6.0	1	3	.8	-	-	9	-	5.8	2.6	A
3S5E-2	May 4, 1943	-	-	-	-	-	-	6.0	2	3	.3	-	-	9	-	5.6	2.6	A

TABLE 13– *Continued*
Patuxent Formation-- *Continued*

Well	Date of collection	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium and potassium (Na+K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Dissolved solids	Total hardness as $CaCO_3$	Total acid	Hydrogen-ion concentration (pH)	Specific conductance ($K \times 10^5$ at 25°C.)	Analyst
3S5E-2	Jan. 22, 1944	7.3	.01	1.4	.8	1.3	-	5.0	1.6	2.2	1.0	-	19	6.8	-	5.4	2.9	A
3S5E-1 & 2	June 12, 1942	-	0	-	-	-	0	.6	.5	.4	-	-	-	2.5	-	5.3	-	K
3S5E-1 & 2	Feb. 2, 1943	-	Trace	-	-	-	0	.6	.5	1.2	-	-	-	1.5	-	5.9	-	K
3S5E-10	May 11, 1943	-	.27	-	-	-	-	63	5	4	.0	.0	-	40	-	6.7	12.1	A
3S5E-11	May 10, 1943	-	-	-	-	-	-	10	2	5	.0	.0	-	10	-	6.4	3.4	A
3S5E-11	June 21, 1945	8.1	.12	1.2	.7	3.5	0	4	3.5	5.9	.1	.0	26	5.9	-	5.4	3.61	A
3S5E-18	Feb. 9, 1945	7.3	.01	.9	.5	3.7	0	6.0	3.5	2.5	.3	.0	20	4.3	-	5.4	2.85	A
3S5E-24	Aug. 11, 1914	-	8.4	-	-	-	-	-	-	9.6	.0	-	-	-	-	-	-	C
3S5E-24	Mar. 8, 1916	-	.4	-	-	-	-	-	-	51	12	-	-	-	-	-	-	C
4S1E-1	July 15, 1943	-	6	-	-	-	-	4	3	6.2	.0	-	-	8	-	6.4	3.2	A
4S2E-1	Feb. 10, 1940	-	.06	-	-	-	-	-	-	216	.2	-	452	-	-	-	-	J
4S2E-2	Sept. 26, 1941	-	32	-	-	-	-	-	-	319	1	-	-	-	-	-	-	J
4S2E-2	July 15, 1943	-	-	-	-	-	-	-	70	710	.0	-	-	330	[b]1.6	4.8	242	A
4S3E-1	July 23, 1943	-	9.1	-	-	-	-	3	6	15	.0	-	-	14	-	5.1	7.7	A
4S3E-3	Aug. 30, 1943	-	-	-	-	-	-	7	7	37	.0	-	-	24	-	5.6	15.7	A
5S2E-1	July 31, 1943	-	-	-	-	-	-	5	1	4	6.5	-	-	12	-	5.4	3.8	A
5S3E-1	Aug. 3, 1943	-	-	-	-	-	0	0	8	47	.2	-	-	38	[b]1.6	4.5	18.7	A
5S3E-2	Oct. 18, 1937	10	.04	-	Trace	-	0	4	7	10	-	-	-	8	-	4.2	-	I
5S3E-21	June 1940	9	-	-	-	-	0	10	13	19	-	-	-	14	-	5.7	-	J
5S3E-33	-	-	-	-	-	-	-	4	15	20	-	-	-	54	-	5.8	-	J
5S3E-36	June 11, 1942	8	.0	-	-	-	-	-	2	118	-	-	-	60	-	4.7	-	E
5S3E-36	Mar. 2, 1943	9	.0	-	-	-	-	-	12	120	-	-	-	58	-	4.9	-	E
5S3E-36	Mar. 2, 1944	-	.06	-	-	-	-	1.0	18	182	1.2	-	-	78	-	5.0	65.5	A
5S3E-37	June 11, 1942	7	.0	34	-	-	-	-	46	324	-	-	-	106	-	4.7	-	E
5S3E-38	June 11, 1942	7	.1	-	-	-	-	-	2	82	-	-	-	40	-	4.7	-	E
5S3E-38	Mar. 2, 1943	8	.2	-	-	-	-	-	4	54	-	-	-	36	-	4.9	-	E
5S3E-38	Mar. 2, 1944	-	.13	-	-	-	-	2.0	18	96	.0	-	-	39	-	4.9	36.7	A
6S2E-1	May 29, 1943	-	.03	-	-	-	0	3.0	4	2.5	.5	.0	-	6	-	5.1	2.5	A
6S2E-1	Jan. 22, 1944	7.9	.09	.8	0.7	1.6	-	2.0	4.2	1.5	.4	-	18	4.9	-	5.0	2.7	A
6S2E-3	May 29, 1943	-	.37	-	-	-	0	0	18	39	.0	.0	-	21	[b]4.8	4.5	18.5	A
6S2E-4	May 29, 1943	-	.02	-	-	-	-	0	24	37	2.4	.0	-	34	-	4.8	19.7	A
6S2E-7	May 29, 1943	-	.04	-	-	-	0	-	14	18	.0	.0	-	16	-	4.8	9.8	A
6S2E-7	Jan. 22, 1944	9.4	.41	1.4	1.1	5.7	0	0	9.5	7.4	.0	-	36	-	-	4.6	5.9	A
6S2E-9	May 29, 1943	-	.12	-	-	-	0	0	115	365	-	.2	-	144	9.2	4.2	142	A
6S2E-9	Jan. 22, 1944	9.6	1.1	24	24	202	-	35	121	360	1.2	-	765	158	-	4.0	143	A
6S2E-12	-	-	.08	-	-	-	-	-	-	-	-	-	-	9.5	-	-	-	J
6S2E-29	Aug. 27, 1943	-	-	-	-	-	-	0	22	97	2.7	-	-	51	-	4.8	40.0	A
6S2E-31	Aug. 27, 1943	-	.60	-	-	-	-	1.0	8	2	.0	-	-	12	-	4.8	2.9	A
6S2E-32	Aug. 27, 1943	-	.93	-	-	-	0	0	110	325	-	-	-	186	[b]26	3.9	138	A
6S3E-1	Aug. 13, 1943	-	29	-	-	-	0	0	10	240	-	-	-	81	[b]37	3.0	107	A

TABLE 13—*Continued*
Patuxent Formation--*Continued*

Well	Date of collection	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium and potassium (Na+K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Dissolved solids	Total hardness as $CaCO_3$	Total acid	Hydrogen-ion concentration (pH)	Specific conductance ($K \times 10^5$ at 25°C.)	Analyst
6S3E-7	May 1940	6.0	9	2.0	.2	-	-	19	4.0	6	-	-	-	46	-	5.8	-	G
6S3E-7	Sept. 1941	4.8	11	7.6	5.0	7	-	19	5.8	5.5	-	-	-	43	-	5.8	-	G
6S3E-7	Aug. 13, 1943	-	19	-	-	-	-	16	6	4	.0	-	-	18	-	6.1	3.5	A
6S3E-8	May 1940	10	12	5.2	.4	-	-	18	9.5	5	-	-	-	63	-	5.6	-	G
6S3E-8	Sept. 1941	7.2	17	12	6.0	38	-	13	16	42	-	-	-	9	-	5.6	-	G
6S3E-8	Aug. 1943	6.4	22	-	-	-	-	-	65	89	96	-	-	-	-	5.4	-	G
6S3E-8	Aug. 13, 1943	-	28	-	-	-	0	0	80	84	.0	-	-	54	[b]30	3.2	63.8	A
7S3E-1	Aug. 13, 1943	-	2.9	-	-	-	0	0	18	1	.1	-	-	14	3.3	4.1	7.5	A
AA-Ad 7	Aug. 19, 1943	-	.57	-	-	-	-	1.0	7	2	.0	-	-	12	-	5.1	2.7	A
AA-Ad 7	June 15, 1945	9.3	.4	1.3	.5	2.5	0	2	6.5	1.4	.0	.0	23	5	-	5.0	2.77	A
AA-Ad 20	June 15, 1945	9.5	1.8	.9	.5	2.8	0	3	5.9	1.4	.0	.0	24	4	-	5.2	2.38	A
AA-Ae 1	Aug. 26, 1943	-	-	-	-	-	-	4.0	7	2	.0	-	-	12	-	6.4	2.7	A
Bal-Ef 1	Apr. 25, 1944	-	-	-	-	-	-	7	1	6	10	-	-	18	-	7.1	5.93	A
Bal-Eg 3	Feb. 10, 1939	-	.75	-	-	-	-	-	-	2.8	.14	-	50	2	-	5.2	-	C
Bal-Eg 3	Jan. 3, 1940	-	.9	-	-	-	-	-	-	5.1	.6	-	328	20	-	5.7	-	C
Bal-Eg 4	Sept. 8, 1943	-	10	-	-	-	-	-	-	4.4	.9	-	312	3	-	6.0	-	C
Bal-Eg 4	Oct. 26, 1944	-	5.6	-	-	-	-	-	-	4.2	.6	-	128	16	-	6.0	-	C
Bal-Fe 2	May 3, 1943	-	-	-	-	-	-	11	6	6.5	1.8	-	-	16	-	5.4	5.1	A
Bal-Fe 3	June 5, 1945	8.5	.53	1.4	.9	5.3	0	8	5.0	4.5	1.1	.0	30	7.2	-	5.3	4.58	A
Bal-Fe 4	May 3, 1943	-	-	-	-	-	-	6.0	6	3	.1	-	-	9.0	-	5.5	2.9	A
Bal-Fe 17	May 4, 1943	-	-	-	-	-	-	5.0	3	3	.2	-	-	15	-	5.4	2.7	A
Bal-Fe 18	Sept. 1927	-	.20	-	-	-	-	-	-	5.2	-	-	-	32	-	-	-	C
Bal-Fe 18	Mar. 18, 1943	-	-	-	-	-	-	-	-	5.9	.0	-	-	-	-	7.5	-	C
Bal-Fe 19	1936	Trace	3	-	-	-	-	-	5	3	-	-	-	12	-	5.6	-	J
Bal-Fe 20	Aug. 5, 1919	-	.0	-	-	-	-	-	-	3.4	.0	-	-	14.4	-	-	-	C
Bal-Fe 20	Mar. 2, 1921	-	.3	-	-	-	-	-	-	3.46	.0	-	-	-	-	-	-	C
Bal-Fe 20	May 17, 1921	-	.2	-	-	-	-	-	-	3.46	.0	-	-	-	-	-	-	C
Bal-Fe 20	July 18, 1927	-	2.5	-	-	-	-	-	-	5.2	-	-	-	16	-	-	-	C
Bal-Fe 20	Jan. 17, 1928	-	.05	-	-	-	-	-	-	4.8	0	-	-	16	-	-	-	C
Bal-Fe 21	July 22, 1918	-	.2	-	-	-	-	-	-	3.8	-	-	-	24	-	-	-	C
Bal-Fe 21	Mar. 2, 1921	-	.3	-	-	-	-	-	-	3.7	.0	-	-	-	-	-	-	C
Bal-Fe 21	May 17, 1921	-	.1	-	-	-	-	-	-	3.0	.0	-	-	-	-	-	-	C
Bal-Fe 21	July 18, 1927	-	.0	-	-	-	-	-	-	5.9	-	-	-	12	-	-	-	C
Bal-Fe 21	Jan. 17, 1928	-	.0	-	-	-	-	-	-	5.2	-	-	-	24	-	-	-	C
Bal-Fe 29	Sept. 27, 1927	-	.0	-	-	-	-	-	-	6.2	-	-	-	32	-	-	-	C
Bal-Ff 34	Jan. 25, 1946	7.1	.71	1.5	1.0	6.3	0	6	6.5	7.2	.9	.0	33	9.9	-	5.3	4.94	A
Bal-Gc 3	Aug. 10, 1944	-	3.3	-	-	-	-	7.0	27	10	11	-	-	51	-	7.3	13.9	A
Bal-Gc 15	Feb. 7, 1935	-	12	-	-	-	-	-	-	17	.0	-	138	70	-	6.6	-	C
Bal-Gc 20	-	-	1.5	-	-	-	-	-	-	9.6	-	-	-	45	-	6.0	-	C
Bal-Ge 2	Apr. 27, 1937	-	1.5	-	-	-	-	-	-	6.2	.0	-	-	2	-	-	-	C

TABLE 13—*Continued*
Patuxent Formation--*Continued*

Well	Date of collection	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium and potassium (Na+K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Dissolved solids	Total hardness as $CaCO_3$	Total acid	Hydrogen-ion concentration (pH)	Specific conductance ($K \times 10^5$ at 25°C.)	Analyst
Bal-Ge 2	Mar. 28, 1939	-	.4	-	-	-	-	-	-	7.0	4.4	-	-	36	-	6.4	-	C
Bal-Ge 2	Apr. 17, 1939	-	-	-	-	-	-	-	-	17	.1	-	-	-	-	6.3	-	C
Bal-Ge 2	Mar. 15, 1940	-	-	-	-	-	-	-	3	12	-	-	66	32	-	-	-	J
Bal-Ge 2	Feb. 26, 1941	-	2.0	-	-	-	-	-	-	20	.1	-	-	13	-	5.9	-	C
Bal-Ge 2	July 22, 1941	-	.46	-	-	-	-	-	-	17	.2	-	-	37	-	6.0	-	C
Bal-Ge 2	Apr. 28, 1942	-	1.8	-	-	-	-	-	-	20	.2	-	-	20	-	5.9	-	C
Bal-Ge 2	June 30, 1943	-	13	-	-	-	-	12	7	18	.0	-	-	18	-	5.9	9.8	A
Bal-Gf 3	Sept. 1937	-	-	-	-	-	0	20	9	11	-	-	-	27	-	5.7	-	F
Bal-Gf 3	Oct. 1937	-	35	-	-	-	0	18	2	9	-	-	-	22	-	5.9	-	F
Bal-Gf 3	Oct. 3, 1939	9.0	9.0	6.5	1.5	-	0	0	11	19	-	-	87	-	-	-	-	F
Bal-Gf 3	Sept. 21, 1940	8.0	.1	8.0	2.0	-	0	8.0	12	18	-	-	-	1.7	-	6.1	-	F
Bal-Gf 4	Jan. 11, 1936	-	-	2.7	-	-	-	-	-	-	-	-	-	-	-	-	-	F
Bal-Gf 4	Sept. 1937	-	-	-	-	-	0	12	10	8	-	-	-	23	-	6.5	-	F
Bal-Gf 4	Oct. 1937	-	33	-	-	-	0	10	2	6.5	-	-	-	14	-	5.9	-	F
Bal-Gf 4	Oct. 3, 1939	5.4	8.8	3.3	.9	-	0	0	16	9.0	-	-	75	-	-	-	-	F
Bal-Gf 5	Sept. 1937	-	-	-	-	-	0	24	9.3	14	-	-	-	25	-	6.1	-	F
Bal-Gf 5	Oct. 1937	-	30	-	-	-	0	20	4	11	-	-	-	24	-	5.7	-	F
Bal-Gf 5	Oct. 3, 1939	12	5.0	5.5	1.7	-	-	-	-	26	-	-	105	-	34	6.1	-	F
Bal-Gf 6	Feb. 11, 1936	-	-	-	-	-	-	-	-	-	-	-	-	-	22	-	-	F
Bal-Gf 6	Sept. 1937	-	-	-	-	-	0	-	9	16	-	-	-	-	-	-	-	F
Bal-Gf 6	Sept. 1, 1937	7.6	7	4.7	4.2	-	-	-	13	35	-	-	100	-	-	-	-	F
Bal-Gf 6	Oct. 1937	-	20	-	-	-	0	14	2	14	-	-	-	18	-	6.3	-	F
Bal-Gf 6	Oct. 3, 1939	7.7	5.9	-	1.5	-	-	-	16	35	-	-	120	-	-	-	-	F
Bal-Gf 8	Aug. 16, 1939	-	-	-	-	-	-	-	-	8	-	-	-	14	-	5.9	-	F
Bal-Gf 8	Oct. 3, 1939	16	9.0	8.5	2.3	-	-	-	10	11	-	-	97	-	-	-	-	F
Bal-Gf 8	Apr. 9, 1943	9.6	6.2	4.4	2.7	10	0	17	9.3	13	.0	.0	55	22	-	5.9	9.3	A
Bal-Gf 9	Nov. 21, 1938	-	10	-	-	-	-	-	-	-	-	-	-	22	-	6.1	-	F
Bal-Gf 9	Oct. 3, 1939	6.9	9.8	5.0	.9	-	-	-	18	9.0	-	-	80	-	-	-	-	F
Bal-Gf 9	Apr. 9, 1943	-	7.4	-	-	-	-	10	10	8.0	.0	-	-	24	-	5.8	6.5	A
Bal-Gf 12	Feb. 2, 1940	12	9.0	6.2	2.1	-	-	-	16	11	-	-	86	-	-	-	-	F
Bal-Gf 12	May 14, 1943	-	7.7	-	-	-	-	23	10	9	.0	.1	-	30	-	7.8	8.3	A
Bal-Gf 16	Feb. 2, 1940	8.8	9.4	7.7	1.8	-	-	-	12	10	-	-	75	-	-	-	-	F
Bal-Gf 16	May 14, 1943	-	8.6	-	-	-	-	22	10	9	.0	.0	-	30	-	6.8	8.4	A
Bal-Gf 32	Dec. 13, 1937	-	15	-	-	-	-	-	15	7	-	-	-	18	-	6.2	-	F
Bal-Gf 32	Dec. 1937	10	-	10	1	-	0	26	11	8	-	-	-	29	-	6.1	-	F
Bal-Gf 32	Oct. 3, 1939	8.2	10	6.9	1.1	-	-	-	12	12	-	-	85	22	-	-	-	F
Bal-Gf 32	July 16, 1943	-	10	-	-	-	-	18	10	14	.0	-	-	32	-	5.9	10.3	A
Bal-Gf 32	Jan. 24, 1944	9.4	28	5.2	3.3	6.2	-	20	11	8.6	.0	-	50	26	-	5.9	9.6	A
Bal-Gf 35	June 11, 1937	-	64	-	-	-	-	-	-	10	-	-	-	-	-	6.3	-	F
Bal-Gf 35	Sept. 4, 1937	-	-	-	-	-	0	28	9.5	8.0	-	-	-	27	-	6.2	-	F

TABLE 13 -- *Continued*
Patuxent Formation -- *Continued*

Well	Date of collection	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium and potassium (Na+K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Dissolved solids	Total hardness as $CaCO_3$	Total acid	Hydrogen-ion concentration (pH)	Specific conductance ($K \times 10^5$ at 25° C.)	Analyst
Bal-Gf 35	Dec. 15, 1937	-	11	-	-	-	-	-	6	7.0	-	-	-	20	-	6.1	-	F
Bal-Gf 35	Oct. 3, 1939	5.7	10	5.1	2.2	-	-	-	17	9.5	-	-	84	22	-	-	-	F
Bal-Gf 35	July 16, 1943	-	8.6	-	-	-	-	18	8	13	-	-	-	-	-	7.6	9.8	A
Bal-Gf 36	Dec. 15, 1937	9.1	-	8	2	-	0	26	9	-	-	-	-	29	-	5.3	-	F
Bal-Gf 36	Dec. 15, 1937	-	7.5	-	-	-	-	-	6	12	-	-	-	20	-	6.2	-	F
Bal-Gf 36	Oct. 3, 1939	6.9	8.8	5.0	1.8	-	-	-	16	11	-	-	81	25	-	-	-	F
Bal-Gf 47	Aug. 30, 1937	8	5.6	5.6	3.5	-	-	-	15	21	-	-	92	-	-	-	-	F
Bal-Gf 48	Aug. 30, 1937	8	9	6	3.8	-	-	-	14	25	-	-	106	-	-	-	-	F
Bal-Gf 51	Aug. 23, 1937	8.4	5	4.3	1.3	-	-	-	13	14	-	-	89	-	-	-	-	F
Bal-Gf 52	Sept. 1, 1937	7.2	6	4.7	4.2	-	-	-	13	39	-	-	110	-	-	-	-	F
Bal-Gf 78[c]	Apr. 25, 1938	-	5.2	-	-	-	-	-	-	8	-	-	63	-	-	6.0	-	F
Bal-Gf 78	Feb. 2, 1940	12.9	12.8	4.1	1.7	-	-	-	10	7.5	-	-	80	-	-	-	-	F
Bal-Gf 93	Sept. 1937	-	-	-	-	-	0	20	10	5	-	-	-	27	-	5.7	-	F
Bal-Gf 93	Oct. 1937	5	3	-	-	-	0	18	2	5.5	-	-	96	-	-	5.8	-	F
Bal-Gf 93	Oct. 3, 1939	9.9	12.2	4.1	1.8	-	-	-	10	8	-	-	84	-	-	-	-	F
Bal-Gf 93	Mar. 11, 1944	8.0	9.2	5.4	5.0	27	-	8	20	47	.0	-	122	34	-	6.0	22.5	A
Bal-Gf 95	Sept. 3, 1937	-	-	-	-	-	0	18	9	5	-	-	-	27	-	6.6	-	F
Bal-Gf 95	Oct. 3, 1939	6.1	9.8	3.6	2.0	-	-	-	10	5.8	-	-	102	-	-	-	-	F
Bal-Gf 105	Sept. 3, 1937	-	-	-	-	-	0	24	2	8.5	-	-	-	21	-	5.5	-	F
Bal-Gf 105	Sept. 3, 1937	-	-	-	-	-	-	18	10	6	-	-	-	-	-	-	-	F
Bal-Gf 105	Sept. 1937	-	-	-	-	-	0	4	13	7	-	-	-	23	-	5.1	-	F
Bal-Gf 105	Oct. 1937	-	32	-	-	-	-	-	-	-	-	-	-	-	-	5.7	-	F
Bal-Gf 139	Jan. 24, 1944	9.7	9.7	4.4	2.6	5.4	-	19	9.8	5.5	.0	-	45	22	-	6.0	8.1	A
Bal-Gf 161	Oct. 7, 1915	-	6.8	-	-	-	-	-	-	1.8	.0	-	-	84	-	-	-	C
Har-Ed 15[c]	Apr. 13, 1944	-	6.7	-	-	-	-	8.0	7	2	.0	-	-	15	-	7.7	3.72	A

Patapsco Formation

Well	Date of collection	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium and potassium (Na+K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Dissolved solids	Total hardness as $CaCO_3$	Total acid	Hydrogen-ion concentration (pH)	Specific conductance ($K \times 10^5$ at 25°C.)	Analyst
2S4E-3	July 21, 1943	-	2.5	-	-	-	-	15	20	16	4.0	-	-	-	-	5.8	15.4	A
2S4E-4	July 16, 1943	-	.45	-	-	-	-	-	-	9.5	-	-	66	45	-	-	-	D

TABLE 13 -- *Continued*

Patapsco Formation -- *Continued*

Well	Date of collection	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium and potassium (Na+K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Dissolved solids	Total hardness as $CaCO_3$	Total acid	Hydrogen-ion concentration (pH)	Specific conductance ($K \times 10^5$ at 25°C.)	Analyst
Bal-Gf 29	Oct. 1937	-	-	-	-	-	-	-	4	42	-	-	-	-	-	4.1	-	F
Bal-Gf 29	Oct. 3, 1939	-	43	17	7.2	-	0	-	30	230	-	-	498	72	-	5.9	-	F
Bal-Gf 30	Dec. 1937	9	-	5.0	-	-	-	-	11	-	-	-	-	12	-	5.0	-	F
Bal-Gf 30	Dec. 13, 1937	-	4.5	-	-	-	-	-	13	12	-	-	-	14	-	5.6	-	F
Bal-Gf 30	Oct. 3, 1939	5.0	5.8	4.5	.4	-	-	-	16	8.0	-	-	74	13	-	5.7	-	F
Bal-Gf 31	Dec. 1937	11	-	8	1	-	-	-	12	5	-	-	-	-	-	5.8	-	F
Bal-Gf 31	Dec. 13, 1937	-	30	-	-	-	-	-	-	9	-	-	-	18	-	6.0	-	F
Bal-Gf 31	Oct. 3, 1939	9.3	17	4.9	.8	-	-	-	16	6.0	-	-	70	16	-	6.3	-	F
Bal-Gf 33	Sept. 4, 1937	-	-	-	-	-	0	18	11	5	-	-	-	15	-	5.9	-	F
Bal-Gf 33	Sept. 13, 1937	-	12	-	-	-	-	-	-	7	-	-	-	12	-	5.9	-	F
Bal-Gf 33	Oct. 3, 1939	12	14	2.8	1.8	-	-	-	11	2.5	-	-	72	20	-	6.3	-	F
Bal-Gf 34	Sept. 4, 1937	-	-	-	-	-	0	-	11	-	-	-	-	11	-	5.1	-	F
Bal-Gf 34	Dec. 13, 1937	-	10	-	-	-	-	-	9	8	-	-	-	10	-	6.0	-	F
Bal-Gf 34	Oct. 3, 1939	11	16	5.1	2.2	-	-	-	15	56	-	-	161	22	-	5.7	-	F
Bal-Gf 37	Dec. 15, 1937	10	-	5	1	-	-	-	14	4	-	-	-	14	-	5.1	-	F
Bal-Gf 37	Oct. 3, 1939	6.2	4.4	3.1	.6	-	-	-	15	11	-	-	60	9.5	-	5.7	-	F
Bal-Gf 39	Dec. 15, 1937	8	-	6	1	-	-	-	10	6	-	-	-	17	-	5.7	-	F
Bal-Gf 39	Feb. 2, 1940	7.1	24	7.0	3.2	-	-	-	22	74	-	-	204	-	-	6.4	-	F
Bal-Gf 46	Aug. 30, 1937	8	11	3.6	3.8	-	-	-	15	25	-	-	98	-	-	6.5	-	F
Bal-Gf 50	Oct. 6, 1937	10	25	11	6.4	-	-	-	12	271	-	-	435	-	-	6.4	-	F
Bal-Gf 79	Sept. 20, 1937	14	24	6	5.6	14	-	-	5.4	99	-	-	177	-	-	6.6	-	F
Bal-Gf 80	Sept. 9, 1937	12	17	4.9	4.9	13	-	-	4.8	57	-	-	138	-	-	6.8	-	F
Bal-Gf 98	Sept. 3, 1937	-	-	-	-	-	0	-	12	3.5	-	-	-	19	-	5.6	-	F
Bal-Gf 98	Feb. 2, 1940	-	-	-	-	-	-	-	12	12	-	-	-	-	-	5.9	-	F
Bal-Gf 100	Sept. 3, 1937	-	-	-	-	-	0	-	12	3	-	-	-	17	-	5.7	-	F
Bal-Gf 106	Sept. 1937	-	-	-	-	-	0	-	14	3	-	-	-	17	-	6.2	-	F
Bal-Gf 106	Aug. 8, 1940	-	40	7.4	6.6	28	0	-	-	130	-	-	-	-	[a]22	-	-	F
Bal-Gf 107	Oct. 1937	7	25	-	-	-	0	-	2	1.5	-	-	-	-	-	6.1	-	F
Bal-Gf 107	Sept. 1937	-	-	-	-	-	0	-	11	6	-	-	-	23	-	5.5	-	F
Bal-Gf 107	Oct. 3, 1939	7.4	8.8	2.6	1.5	-	-	-	11	7.8	-	-	-	68	-	6.7	-	F
Bal-Gf 108	Sept. 1937	-	-	-	-	-	0	-	-	3	-	-	-	17	-	5.9	-	F
Bal-Gf 108	Oct. 1937	6	30	-	-	-	0	-	2	3	-	-	-	-	-	5.5	-	F
Bal-Gf 108	Oct. 3, 1939	7.4	9.0	2.7	1.3	-	-	-	11	5.3	-	-	60	-	-	6.6	-	F
Bal-Gf 137	Jan. 24, 1944	7.7	35	15	25	208	-	8	50	398	.5	-	728	140	-	3.8	143	A
Bal-Gf 157	Oct. 7, 1915	-	2.4	-	-	-	-	-	-	2.5	-	-	-	68	-	-	-	C
Bal-Gf 158	Oct. 7, 1915	-	2.4	-	-	-	-	-	-	3	.0	-	-	20	-	-	-	C
Bal-Gf 159	Oct. 7, 1915	-	4.4	-	-	-	-	-	-	2.2	.0	-	-	72	-	-	-	C
Bal-Gf 160	Oct. 7, 1915	-	13	-	-	-	-	-	-	3.5	.0	-	-	56	-	-	-	C
Bal-Gf 166	Dec. 13, 1937	-	20	-	-	-	-	-	10	38	-	-	-	26	-	5.5	-	F
Bal-Gf 166	July 21, 1938	-	14	-	-	-	-	-	-	42	-	-	158	6	-	6.8	-	F
Bal-Gf 167	Feb. 2, 1940	11	5.0	2.3	.6	-	-	-	15	8.0	-	-	86	-	-	6.4	-	F
Bal-Gf 168	Sept. 14, 1937	8.0	6.0	2.6	1.1	-	-	-	14	8.5	-	-	75	-	-	5.6	-	F

TABLE 13 -- *Continued*
Patapsco Formation -- *Continued*

Well	Date of collection	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium and potassium (Na+K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Dissolved solids	Total hardness as $CaCO_3$	Total acid	Hydrogen-ion concentration (pH)	Specific conductance ($K \times 10^5$ at 25°C)	Analyst
3S5E-9	Mar. 19, 1945	9.0	.1	8.2	6.7	51	0	1.0	3.6	107	3.5	.1	214	48	-	5.3	-	A
6S2E-10	May 29, 1943	-	.08	-	-	-	0	0	85	32	17	.1	-	-	-	4.8	31.7	A
6S2E-10	Jan. 22, 1944	8.6	1.2	18	11	32	-	0	79	51	15	-	232	90	-	4.7	39.7	A
6S4E-1	Sept. 14, 1943	-	1.3	-	-	-	0	0	190	880	-	-	-	330	[b]32	4.0	310	A
7S3E-2	Aug. 13, 1943	-	-	-	-	-	-	3	1	5	9.1	-	-	18	-	6.4	4.5	A
AA-Ad 1	June 21, 1943	-	-	-	-	-	-	4	1	2.8	5.6	-	-	10	-	6.7	4.4	A
AA-Ad 1		-	.0	-	-	-	-	-	-	3.6	-	-	-	2.0	-	5.2	-	J
AA-Ad 2	June 21, 1943	-	-	-	-	-	-	4	1	3.5	8.6	-	-	16	-	6.0	4.0	A
AA Ad 2	-	.38	.04	-	.4	-	0	-	.7	-	-	-	-	-	-	-	-	J
AA Ad 3	Apr. 3, 1941	-	.02	-	-	-	-	-	-	5.9	-	-	-	7.2	-	5.6	-	J
AA-Ad 3	June 21, 1943	-	-	-	-	-	-	6	1	5.5	10	-	-	18	-	6.9	5.3	A
AA-Ad 4	Aug. 19, 1943	-	-	-	-	-	-	6	1	5	8.4	-	-	18	-	6.8	4.4	A
AA-Ad 5	Aug. 2, 1943	-	-	-	-	-	-	6	1	13	4.2	-	-	18	-	6.4	-	A
AA-Ad 5	June 15, 1945	7.7	.04	2.2	.9	4.5	0	6	.6	5.5	5.8	.0	36	9.2	-	5.7	4.20	A
AA-Ad 6	Aug. 19, 1943	-	.35	-	-	-	-	5	1	5	6.1	-	-	18	-	6.4	4.0	A
AA-Ad 17	Mar. 31, 1914	-	-	-	-	-	-	-	-	9.4	-	-	-	6	-	-	-	C
AA-Ad 18	Mar. 31, 1914	-	-	-	-	-	-	-	-	7.2	-	-	-	13	-	-	-	C
AA-Ae 2	Aug. 24, 1943	-	.79	-	-	-	-	22	46	14	9.1	-	-	68	-	5.6	20.6	A
AA-Ae 3	Aug. 24, 1943	-	-	-	-	-	-	35	70	17	.1	-	-	87	-	6.3	26.9	A
AA-Ae 4	Jan. 31, 1944	-	-	-	-	-	0	0	16	4	.5	-	-	10	[b]4.8	4.3	6.4	A
AA-Bc 1	July 24, 1944	-	.28	-	-	-	-	-	-	-	10	-	26	19	-	4.9	-	D
AA-Be 3	Sept. 17, 1935	-	6	-	-	-	-	-	-	4.2	0	-	-	16	-	5.8	-	C
AA-Bf 1	Aug. 3, 1943	-	18	-	-	-	-	20	2	3.0	.0	-	-	16	-	6.1	7.1	A
AA-Bf 2	Aug. 3, 1943	-	7.5	-	-	-	-	-	2	1.5	.0	-	-	18	[b]2.4	4.2	5.6	A
AA-Bf 4	Aug. 3, 1943	-	-	-	-	-	-	3.0	6	4.2	1.0	-	-	12	-	6.0	3.2	A
Bal-Eg 5	Jan. 11, 1939	-	1.0	-	-	-	-	-	-	4.0	.0	-	30	8	-	6.1	-	C
Bal-Gf 14	Feb. 2, 1940	8.8	22	11	3.5	-	-	-	13	70	-	-	210	-	-	6.1	-	F
Bal-Gf 14	May 14, 1943	-	95	-	-	-	0	0	24	240	-	.0	-	84	[b]74	2.8	127	A
Bal-Gf 18	Feb. 2, 1940	8.1	24	9.7	2.0	-	-	-	21	66	-	-	274	-	-	6.6	-	F
Bal-Gf 18	May 14, 1943	-	101	-	-	-	0	0	24	245	-	-	-	84	[b]74	2.9	108	A
Bal-Gf 24	Feb. 2, 1940	6.8	30	9.2	5.3	-	-	-	12	78	-	-	220	-	-	5.7	-	F
Bal-Gf 25	Feb. 2, 1940	11	24	6.7	3.2	-	-	-	13	20	-	-	124	-	-	6.4	-	F
Bal-Gf 28	Jan. 10, 1936	11.2	2.4	2.2	9.4	-	-	-	7.8	-	-	-	-	-	-	-	-	F
Bal-Gf 28	Feb. 10, 1936	-	2.7	-	-	-	-	-	-	21	-	-	-	-	-	-	-	F
Bal-Gf 28	Sept. 1937	-	-	-	-	-	0	-	12	93	-	-	-	44	-	4.0	-	F
Bal-Gf 28	Oct. 1937	-	85	-	-	-	-	-	4	94	-	-	-	-	-	3.9	-	F
Bal-Gf 28	May 2, 1938	-	40	-	-	-	-	-	-	-	-	-	-	-	-	5.9	-	F
Bal-Gf 28	Oct. 13, 1938	-	60	-	-	-	-	-	42	503	-	-	-	248	-	5.4	-	F
Bal-Gf 28	Oct. 3, 1938	17	74	38	22	-	0	-	41	450	-	-	1,048	-	-	6.2	-	F
Bal-Gf 28	Feb. 3, 1944	12	56	33	18	113	0	0	14	320	.0	-	507	156	[b]64	2.9	145	A
Bal-Gf 29	Jan. 10, 1936	11	3.1	.7	1.5	8.3	-	-	8.6	13	-	-	94	-	-	-	-	F
Bal-Gf 29	Sept. 1937	-	-	-	-	-	0	-	13	36	-	-	-	21	-	4.0	-	F

TABLE 13 – *Continued*
Patapsco Formation--*Continued*

Well	Date of collection	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium and potassium (Na+K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Dissolved solids	Total hardness as $CaCO_3$	Total acid	Hydrogen-ion concentration (pH)	Specific conductance ($K \times 10^5$ at 25°C)	Analyst
Bal-Gf 168	Dec. 13, 1937	-	10	-	-	-	-	-	12	3	-	-	-	8	-	6.0	-	F
Bal-Gf 168	July 21, 1938	-	9	-	-	-	-	-	-	3.4	-	-	60	10	-	6.9	-	F
Bal-Gf 169	Oct. 26, 1937	8.4	20	4.7	3.2	-	-	-	12	114	-	-	200	-	-	6.4	-	F
Bal-Gf 169	Dec. 15, 1937	-	15	-	-	-	-	-	-	27	-	-	-	20	-	4.0	-	F
Bal-Gf 169	July 21, 1938	50	12	-	-	-	-	-	-	30	-	-	144	6	-	6.6	-	F
Bal-Gf 170	Sept. 14, 1937	7.2	7	4.6	.7	-	-	-	11	11	-	-	68	-	-	6.5	-	F
Bal-Gf 170	Dec. 15, 1937	-	7.5	-	-	-	-	-	6	3	-	-	-	10	-	6.3	-	F
Bal-Gf 170	July 21, 1938	-	6	-	-	-	-	-	-	4.6	-	-	76	-	-	6.8	-	F
Bal-Gf 171	Sept. 14, 1937	6.8	10	4.6	2.8	-	-	-	12	11	-	-	88	-	-	6.5	-	F
Bal-Gf 171	Dec. 15, 1937	-	7.5	-	-	-	-	-	6	5	-	-	-	-	-	6.0	-	F
Bal-Gf 171	July 21, 1938	-	13	-	-	-	-	-	-	12	-	-	96	-	-	-	-	F
Bal-Gf 172	Dec. 14, 1937	9.0	8	3.1	3.8	-	-	-	13	14	-	-	96	-	-	6.2	-	F
Bal-Gf 172	Dec. 15, 1937	-	10	-	-	-	-	-	6	15	-	-	-	14	-	6.1	-	F
Bal-Gf 172	July 21, 1938	-	12	-	-	-	-	-	-	11	-	-	80	-	-	6.7	-	F
Bal-Gf 173	Dec. 15, 1937	-	20	-	-	-	-	-	6	12	-	-	-	12	-	6.2	-	F
Bal-Gf 173	July 21, 1938	-	4	-	-	-	-	-	-	5.4	-	-	66	-	-	6.5	-	F
Bal-Gf 174	Dec. 15, 1937	-	8	-	-	-	-	-	9	7	-	-	-	10	-	6.0	-	F
Bal-Gf 174	July 21, 1938	-	12	-	-	-	-	-	-	3.4	-	-	72	-	-	6.7	-	F
Bal-Gf 175	Sept. 4, 1937	10	-	2.5	2.2	-	-	-	13	14	-	-	80	-	-	5.6	-	F
Bal-Gf 175	Dec. 15, 1937	-	1.2	-	-	-	-	-	6	10	-	-	-	12	-	5.2	-	F
Bal-Gf 175	Mar. 10, 1938	-	2	-	-	-	-	-	13	8	-	-	-	17	-	5.4	-	F
Bal-Gf 175	July 21, 1938	10	-	-	-	-	-	-	-	8	-	-	74	8	-	-	-	F
Bal-Gf 175	Jan. 24, 1944	8.5	21	5.2	4.9	29	-	15	13	70	0	-	127	33	-	3.5	35.0	A
Bal-Gf 176	Mar. 3, 1944	8.0	15	5.4	4.1	14	0	0	15	57	.4	-	118	30	[b]10	4.3	-	A
Bal-Gf 179	June 3, 1943	-	23	-	-	-	0	18	1	4	.0	.5	-	16	-	6.8	6.8	A
Bal-Gf 179	Oct. 22, 1945	7.7	11	2.6	2.0	3.4	0	8	11	1.6	.1	.2	33	15	-	5.9	4.64	A
Bal-Gf 180	Aug. 1938	-	3.5	8.2	4.3	-	-	-	20	0	-	-	-	37	-	-	-	J
Bal-Gf 180	Dec. 1, 1942	8.9	.0	10	.44	-	0	-	11	3	-	.2	58	-	-	-	-	C
Bal-Gf 180	June 3, 1943	-	14	-	-	-	0	11	10	2	.0	.1	-	18	-	6.7	4.6	A
Bal-Gf 182	Dec. 1, 1930	-	7.0	-	-	-	-	-	-	1.4	4.0	-	-	24	-	7.2	-	C
Bal-Gf 182	Apr. 15, 1931	-	4.0	-	-	-	-	-	-	5.0	0	-	-	64	-	6.8	-	C
Bal-Gf 182	May 15, 1931	-	7.0	-	-	-	-	-	-	6.4	.4	-	-	16	-	6.0	-	C
Bal-Gf 182	Nov. 10, 1931	-	7.2	-	-	-	-	-	-	5.4	0	-	-	8	-	6.2	-	C
Bal-Gf 183	Dec. 1, 1930	-	6.5	-	-	-	-	-	-	3.8	1.0	-	-	8	-	6.9	-	C
Bal-Gf 183	Apr. 15, 1931	-	4.0	-	-	-	-	-	-	4.4	0	-	-	40	-	5.8	-	C
Bal-Gf 183	May 15, 1931	-	4.0	-	-	-	-	-	-	6.4	.1	-	-	16	-	5.8	-	C
Bal-Gf 183	Nov. 10, 1931	-	9.6	-	-	-	-	-	-	6.0	.0	-	-	32	-	6.4	-	C
Bal-Gf 187	Oct. 16, 1930	-	4.0	-	-	-	-	-	-	1.0	.1	-	-	16	-	6.6	-	C
Bal-Gf 187	May 22, 1932	-	10.0	-	-	-	-	-	-	13	.0	-	-	12	-	6.0	-	C
Bal-Gf 187	Sept. 26, 1932	-	9.6	-	-	-	-	-	-	11	.0	-	-	18	-	6.6	-	C
Bal-Gf 188	Jan. 23, 1930	-	.3	-	-	-	-	-	-	284	.8	-	-	128	-	-	-	C
Bal-Gf 188	May 5, 1930	-	1.8	-	-	-	-	-	-	18.6	4.0	-	-	72	-	6.2	-	C

TABLE 13 – *Continued*

Patapsco Formation – *Continued*

Well	Date of collection	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium and potassium (Na+K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Dissolved solids	Total hardness as $CaCO_3$	Total acid	Hydrogen-ion concentration (pH)	Specific conductance ($K \times 10^5$ at 25°C.)	Analyst
Bal-Gf 188	Nov. 18, 1930	-	2.0	-	-	-	-	-	-	35	4.0	-	-	8	-	7.0	-	C
Bal-Gf 190	Sept. 22, 1931	-	.5	-	-	-	-	-	-	33	1.0	-	-	24	-	5.0	-	C
Bal-Gf 192	Mar. 7, 1944	6.2	53	18	16	158	0	0	46	335	1.0	-	623	111	[b]17	3.7	166	A
Har-Ed 19	Apr. 13, 1944	-	.03	-	-	-	-	7	11	7	.2	-	-	15	-	7.4	5.93	A

Pleistocene Deposits

Well	Date of collection	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium and potassium (Na+K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Fluoride (F)	Dissolved solids	Total hardness as $CaCO_3$	Total acid	Hydrogen-ion concentration (pH)	Specific conductance ($K \times 10^5$ at 25°C.)	Analyst
1S1E-2	June 9, 1944	-	1.6	-	-	-	-	260	125	1,770	15	-	-	765	-	8.3	604	A
1S1E-10	June 13, 1944	-	3.3	-	-	-	-	78	105	100	77	-	-	186	-	8.1	85.8	A
2S1E-41	May 29, 1944	-	83	-	-	-	-	545	560	4,950	-	-	-	1,710	-	7.0	1,520	A
2S1E-73	May 29, 1944	-	-	-	-	-	-	400	700	750	-	-	-	465	-	6.3	557	A
2S1W-10	May 25, 1944	-	4.8	-	-	-	-	166	200	48	.2	-	-	264	-	7.3	69.6	A
1N5E-1	June 1943	-	-	-	-	-	-	89	46	38	.2	-	-	105	-	6.9	40.6	A
Bal-Fe 22	Aug. 20, 1930	-	.2	-	-	-	-	-	-	15	3.0	-	-	32	-	6.8	-	C
Bal-Fe 23	Aug. 20, 1930	-	.1	-	-	-	-	-	-	37	5.0	-	-	64	-	6.0	-	C
Bal-Fe 26	Aug. 11, 1914	-	.15	-	-	-	-	-	-	43	2.6	-	-	-	-	-	-	C
Bal-Fe 27	Aug. 11, 1914	-	.05	-	-	-	-	-	-	38	6.2	-	-	-	-	-	-	C
Bal-Ff 2	Sept. 8, 1943	-	-	-	-	-	-	7	95	82	25	-	-	92	-	5.4	55.3	A
Bal-Gc 1	Jan. 25, 1943	-	8.8	-	-	-	-	-	-	9.8	.0	-	202	4.6	-	6.3	-	J
Bal-Gc 1	Oct. 6, 1943	-	7.6	-	-	-	-	56	10	10	1.0	-	-	45	-	6.6	-	A
Har-De 6	July 7, 1944	-	.05	-	-	-	-	8.0	1	15	22	-	-	33	-	7.2	11.5	A
Har-De 18	Sept. 12, 1944	-	14	-	-	-	-	18	20	9	11	-	-	36	-	7.5	13.2	A
Har-Ed 14	Apr. 13, 1944	-	.03	-	-	-	-	10	8	17	2.5	-	-	26	-	7.4	10.4	A

ANALYSTS:

A - U. S. Geological Survey, Washington, D.C., Laboratory
B - Strasburger and Siegel
C - Maryland State Health Department
D - Penniman & Browne, Baltimore
E - Beta Laboratories, Philadelphia
F - Bethlehem Steel Co.
G - Davison Chemical Corp.
H - U. S. Industrial Chemical Co.
I - Hall Laboratory
J - Analyst not known
K - Feedwaters Inc.

total hardness, 30 to 123; chloride, 4 to 12; sulfate, 1 to 20; bicarbonate, 4 to 144; and iron, 1 to 8. The analysis for well Bal-Fc 1 shows a nitrate content of 25 parts per million, suggesting that the water may be polluted with organic matter.

Except for the rather high content of iron in the water in some parts of the crystalline-rock area, the water generally is satisfactory in chemical character for most uses.

PATUXENT FORMATION

A large number of chemical analyses were made of water from wells ending in the Patuxent formation; these analyses show that most of the water was contaminated at least to a small degree. Twenty-two analyses were selected as showing little or no contamination and considered representative of the uncontaminated water in the Patuxent formation in the Baltimore area. Of these analyses 10 are complete, having all the common mineral constituents determined. The remainder are partial analyses in which in general only the following constituents were determined: bicarbonate, sulfate, chloride, nitrate, total hardness, and pH. The range in the constituents in parts per million in these 22 analyses, is:

	Low	*High*	*Average*
Silica	7.1	9.7	8.4
Iron	.01	28	5.0
Calcium	.8	5.2	1.9
Magnesium	.5	3.3	1.2
Sodium and potassium	1.3	6.3	3.9
Carbonate	.0	.0	.0
Bicarbonate	1.0	20	7.1
Sulfate	1	18	5.8
Chloride	1	8.6	3.7
Nitrate	.0	6.5	1.1
Fluoride	.0	.0	.0
Dissolved solids	18	50	29
Total hardness	4.3	26	11
pH	4.1	6.8	5.5

This summary shows that the water is very soft, having an average total hardness of 11 parts per million, and low in dissolved solids, having an average of 29 parts per million. The average pH is 5.5 which is rather low

—that is, the water is on the acid side though at a pH of 5.5 free acid is not present. The average iron content of 5.0 parts per million is not representative, as a few very high figures cause the average to be disproportionately high. Nevertheless, a number of water users in the area treat the water for removal of iron.

In general the water is satisfactory in chemical quality for most uses, but the low mineral content and low pH cause the water in some parts of the area to be corrosive. For example, the screen in well 6S2E-1, Curtis Bay district, was corroded considerably during the 4 years it was in use (Pl. 24 B). The chemical analysis of the water from this well shows only 18 parts per million of dissolved solids and a total hardness of only 4.9. The water probably contains carbon dioxide, which would increase its corrosiveness.

PATAPSCO FORMATION

The chemical quality of uncontaminated water in the Patapsco formation is typified by the analysis for well Bal-Gf 179. This analysis, which shows the water to be very soft and to have a low mineral content, is similar to analyses of water from the Patuxent formation. A summary of 11 analyses of uncontaminated water from the Patapsco formation, of which most are partial analyses, is in parts per million:

	Low	*High*	*Average*
Iron	0.04	14	3.8
Bicarbonate	3	20	7.1
Sulfate	.6	16	4.7
Chloride	1.5	5.5	3.5
Nitrate	.0	9.1	4.2
Fluoride	.0	.2	.2
Dissolved solids	33	36	35
Total hardness	9.2	18	15
pH	4.2	6.7	5.9

The iron content typically is much higher in the Baltimore industrial area than that of the water from the Patuxent formation, even though the arithmetic average for the 11 samples is 3.8 parts per million, as compared with the similarly unadjusted average of 5.0 for the Patuxent formation. The iron content of water from both formations has a wide range and may differ markedly within a single well field.

PLEISTOCENE DEPOSITS

The chemical quality of water from the Pleistocene deposits has a wider range than water from the underlying Cretaceous sediments. Most of the samples of water from the Pleistocene deposits were collected from wells that are contaminated by highly mineralized water; consequently most of the analyses of water from wells in the Pleistocene deposits in Table 13 are of little value in showing the character of the uncontaminated water. The only analyses made by the Geological Survey that appear to be of water essentially free from contamination are those for wells Bal-Gc 1, Har-De 6, Har-De 18, and Har-Ed 14. These analyses show the following range in mineral constituents in parts per million: iron, 0.03 to 14; bicarbonate, 10 to 56; sulfate, 1 to 20; chloride, 9 to 17; nitrate, 1 to 22; total hardness, 26 to 45; and pH, 6.6 to 7.5. These analyses indicate that the bicarbonate content and pH are higher than they generally are in water from the Cretaceous sediments.

MINERAL CONTAMINATION OF THE GROUND WATER

The preceding summary of analyses indicates that prior to the development of large ground-water supplies in the Baltimore area practically all the ground water had a low mineral content. This may appear incongruous as in the estuaries salt water covers parts of the outcrops of all the unconsolidated sediments.

GHYBEN-HERZBERG PRINCIPLE AND ITS APPLICATION TO THE CONTAMINATION OF THE GROUND WATER

The occurrence of fresh ground water in contact with salt water was first studied in Europe by Ghyben (1889, p. 21) and by Herzberg (1901), who apparently was not aware of any earlier work.

They found that in wells drilled near the seashore fresh water occurred below sea level to a depth equal to about 40 times the height of the fresh water above sea level. As the average specific gravity of sea water is about 1.025 and fresh water about 1.0, or about 41 to 40, it was concluded that the fresh water and salt water were in a state of equilibrium in which a vertical column of salt water 40 feet high balanced a proportionately longer vertical column, 41 feet high, of the less dense fresh water; the proportions would hold so long as the fresh water formed a sharp contact with the salt water. This relationship, which is generally applied to salt water having the density of sea water, has led to a general rule of a 40-to-1 ratio; that is, the depth in feet below sea level to the contact between fresh and salt water theoretically will be 40 times the number of feet the static level of the fresh water is above sea level.

In the Baltimore area, however, the water in the estuaries, for example in the Patapsco River estuary, is considerably less salty than sea water; consequently its density is lower than 1.025 and accordingly the ratio is much higher than 40 to 1. Figure 19 shows the approximate relation of various

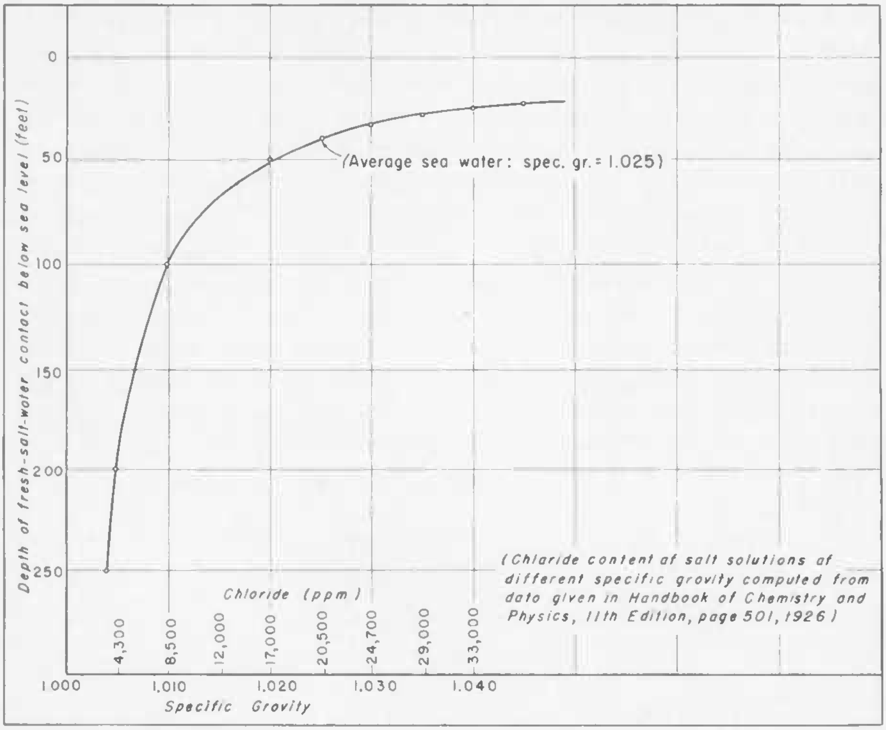


FIGURE 19. Relation of specific gravity of various concentrations of aqueous solutions of sodium chloride to the depth below sea level of the contact between fresh and salt water when the fresh-water head is 1 foot above sea level—according to the Ghyben-Herzberg principle

concentrations of aqueous solutions of sodium chloride to this ratio. The chloride content of the water in the Patapsco River estuary probably has a wide range but in general is about 2,000 to 5,000 parts per million. At the latter concentration the ratio theoretically would be approximately 250 to 1 instead of 40 to 1. Hence, under ideal conditions, the contact between salt and fresh water, for example near the Patapsco River estuary, would be much steeper and the fresh water would extend to a greater depth than it would under a ratio of 40 to 1.

Although Ghyben and Herzberg apparently considered that hydrostatic equilibrium existed between the fresh water and salt water, complete equilibrium probably never exists in nature; moreover, if it did, the principle they set forth would not hold, at least after a period of time. As has been pointed out by Hubbert (1940, pp. 924-926), and Krul and Liefrinck (1946, pp. 15-17,) the Ghyben-Herzberg principle can apply only to flowing fresh and salt water in dynamic equilibrium.

The general relation between fresh and salt water in shallow aquifers near the estuaries in the Baltimore area is shown in Figure 20 A. This section is idealized; owing to the presence of clay beds and other relatively impervious material the position of the contact between fresh and salt water probably would be considerably different than shown in the figure; nevertheless, the basic principles that it demonstrates would still apply. Under natural conditions, before pumping, it is not likely that salt water extended to any great depth below the Patapsco River estuary or Chesapeake Bay, for relatively impervious clay beds would have so retarded vertical movement of water that lateral movement of water in aquifers below the clay beds would have kept the water fresh. Hence it is probable that, under natural conditions, the depth to which salt water extended beneath the estuaries was limited largely by the clay beds or other relatively impervious material and not by the density relation of salt and fresh water in accordance with the Ghyben-Herzberg principle. Also, as the unconsolidated sediments in the Baltimore area generally are irregular and lenticular it is likely that the depth of salt water beneath the estuaries had a wide range.

The Ghyben-Herzberg principle also has been applied to artesian conditions—for example, along the coast of New Jersey (Barksdale, Sundstrom,

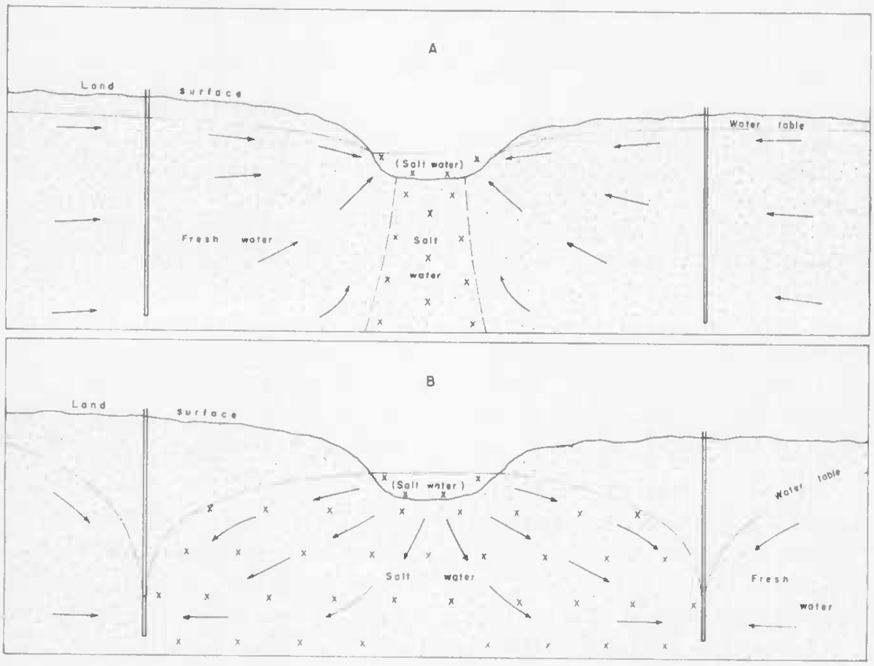


FIGURE 20. Idealized diagram showing the movement of water in the shallow aquifers in the vicinity of the estuaries in the Baltimore area: A, movement under natural conditions before ground-water pumping began; B, movement during pumping of ground water

and Brunstein, 1936, pp. 25-37); although artesian conditions in nature seldom approach the conditions assumed in this application of the principle it is the best method available for analyzing the relation between salt and fresh water in artesian aquifers that are hydrologically connected to the sea or other bodies of salt water.

As has been shown previously, the major artesian aquifers in the Baltimore area dip southeastward toward the Atlantic Ocean, and though the permeable water-bearing material may not be exposed directly to the salt water in the Atlantic Ocean, none of the sediments are so impervious that the penetration of salt water would be completely prevented. Thus, according to the Ghyben-Herzberg principle, the depth to which fresh water would extend in an artesian aquifer would be governed by the height above sea level of the water table in the outcrop area. If, for example, the water table were 100 feet above sea level and the salt water had a density of 1.025, according to the principle the contact between fresh and salt water would be 4,000 feet below sea level. As has been pointed out, however, this principle assumes that the fresh water and salt water are in hydrostatic equilibrium, a condition that is rarely attained in nature. To apply the Ghyben-Herzberg principle to the artesian aquifers in the Baltimore area it is necessary to consider the manner in which fresh water circulates in the aquifer from its outcrop to outlets of natural discharge; the pattern of circulation is shown in Figure 21.

The confining beds that overlie the artesian aquifers are not completely impermeable, and water can move down the dip through the aquifer and thence upward to surface streams or the atmosphere. This movement of water cannot occur without a hydraulic gradient; therefore under natural conditions the piezometric surface would slope southeastward toward the Atlantic Ocean. If the transmissibility of the aquifer were uniform the piezometric surface would slope at a decreasing rate toward the southeast, because the quantity of water flowing through the aquifer would decrease toward the southeast as the water leaked upward through the confining beds. The decrease in hydraulic gradient would be accentuated by the relatively greater natural discharge in the up-dip part of the aquifer, where the confining beds are thinner. Because of its slope the piezometric surface would be lower in the down-dip part of the aquifer than in the outcrop, and accordingly the depth to which fresh water would extend down the artesian aquifer would be less than indicated by the Ghyben-Herzberg principle for a condition of hydrostatic equilibrium.

The position of the salt-water front in the Patuxent and Patapsco formations is not known accurately. With respect to the Patuxent formation, well Bal-Gf 186 at Bay Shore Park, which ends in that formation and is about 10 miles down dip from the outcrop area, yields water of low chloride content. However, a well drilled to a depth of 1,135 feet at Chestertown, and

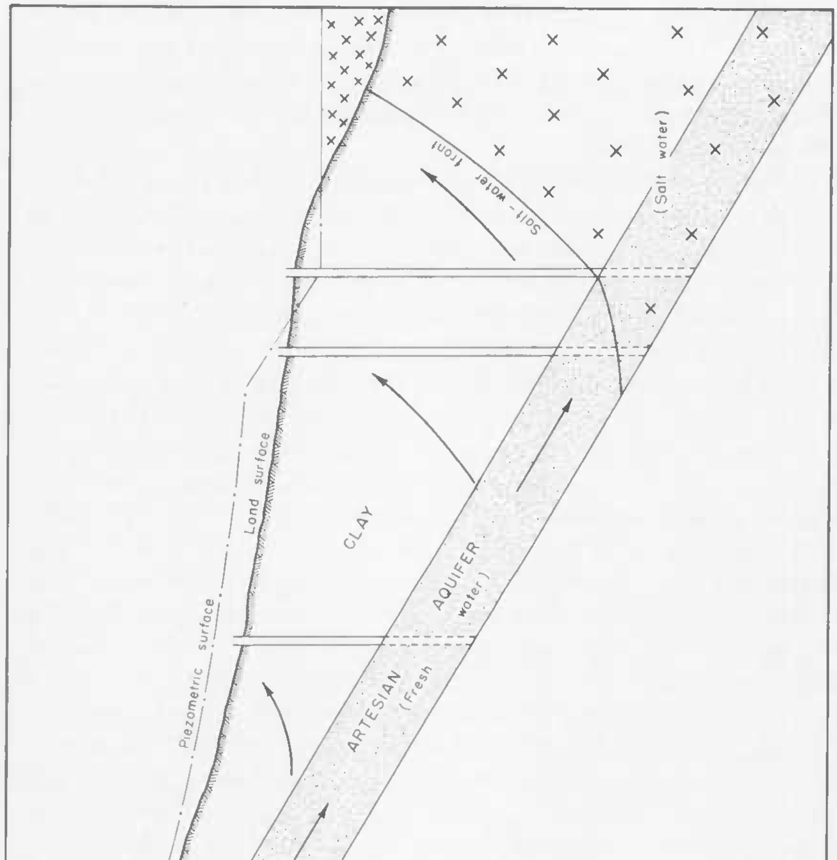


FIGURE 21. Schematic diagram showing the position of the salt-water front formed by circulation of water from an artesian aquifer

ending in the Patuxent formation encountered very salty water (Clark, Mathews, and Berry, 1918, pp. 270-272). The Chestertown well is about 20 miles down dip from the outcrop. This would suggest that the salt-water front in the Patuxent formation may be somewhere between 10 and 20 miles southeast of the outcrop; however, the salt-water front probably is not equidistant from the outcrop at all points. The water table in the outcrop area of the Patuxent formation generally is higher in the southern part of the area; consequently the salt-water front may be farther southeast of the outcrop in the southern part of the area than in the northern part, where the water table generally is at a lower altitude.

Few data are available on the position of the salt-water front in the Patapsco formation, but wells in the Annapolis area, which is about 12 miles southeast of the center of pumping in the Patapsco formation in the Baltimore industrial area, draw fresh water from that formation.

With the development of ground-water supplies and the accompanying withdrawal of large quantities of ground water, the dynamic equilibrium between salt and fresh water was upset in some parts of the area. The lowering of the water table below the level of the salt water in the Patapsco River estuary allowed the salt water to flow from the estuary into the fresh-water aquifers (fig. 20 B). Up to the present time this has been the only manner in which salt water has encroached into the aquifers in the Baltimore area; however, pumping of water from the Patuxent formation may also have caused an advance of the salt-water front up dip toward the heavily pumped areas, though no information is available to indicate whether this has happened. If the artesian head in the Patuxent formation has been lowered sufficiently in and southeast of the Baltimore industrial area so that there is now a northwestward hydraulic gradient toward the Baltimore area all the way from the area where salt water is present in the formation, then it is merely a question of time until the salt water reaches the centers of pumping in the Patuxent formation. It is possible, however, that the cone of depression in the Patuxent formation reached equilibrium before extending to the salt water that is contained in the formation at some distance southeast of the Baltimore industrial area—that is, that a "fresh-water divide" above sea level remains southeast of Baltimore. Because it is not yet known, therefore, whether up-dip encroachment of salt water in the Patuxent formation may be possible, it would be advisable to take measures for detecting any encroachment before it reaches the heavily pumped areas. As the greatest down-dip extension of the cone of depression is southeast of the Sparrows Point district, it is likely that any salt water moving up dip would first reach wells tapping the Patuxent formation in that district. The diagram showing flow lines and equipotential contours (Pl. 7) indicates that if salt water does encroach it may appear first in the Bay Shore Park area (well Bal-Gf 186) before reaching the heavily pumped Sparrows Point district. Thus periodic analysis of chloride in samples of water from that well may afford a means of detecting an advance of the salt-water front before it reaches the heavily industrialized Sparrows Point district.

Insofar as existing ground-water developments are concerned the up-dip encroachment of salt water in the Patuxent formation should not be considered as constituting an immediate danger. It is not known that it is actually taking place; and, even if it is, its rate of advance probably is so slow that it would require many years to advance from the vicinity of Bay Shore Park, where it probably could be detected first, to the heavily pumped wells in the Sparrows Point district. Nevertheless, careful consideration should be given to the possibility of up-dip encroachment of salt water before large ground-water supplies are developed from the Patuxent formation southeast of the Sparrows Point district.

Because the cone of depression in the Patapsco formation is much smaller than that in the Patuxent formation and the position of the salt-water front is farther southeast, the possibility of up-dip encroachment of salt water into the Baltimore industrial area in the Patapsco formation appears remote.

SALT-WATER CONTAMINATION FROM THE PATAPSCO RIVER ESTUARY

Salt-water contamination, chiefly in the Patuxent formation and Pleistocene deposits, was present in a small part of the area about 50 years ago, for Darton's study (1896, pp. 139-140) of the ground water-conditions in the Baltimore area about 1890 to 1895 disclosed that a few wells in the Harbor district were contaminated by salt water. These wells were probably close to the Patapsco River, for at that time most wells in the area apparently yielded water of good chemical quality. As pumping increased in the Harbor and Canton districts, contamination became more widespread and many wells were abandoned. Records of wells in the Baltimore area obtained in 1909 and 1916 (Clark, Mathews, and Berry, 1918, pp. 338-364) indicate that many wells in the Harbor district and the western part of the Canton district had become contaminated with salt or brackish water.

Up to 1916 there was little or no contamination in the Highlandtown, Sparrows Point, Dundalk, Curtis Bay, and Fairfield districts; however, an investigation by Singewald (1920) for the U. S. Industrial Chemical Co. showed that, in 1920, a few wells ending in the Patapsco formation in the Curtis Bay district had become contaminated with salt water. The Patapsco formation was contaminated by salt water chiefly between 1920 to 1940, as it was during that period that many large ground-water supplies were developed near the Patapsco River estuary.

The approximate areal extent of contamination in the Patuxent formation in 1945, caused by salt water in the Patapsco River estuary moving directly into the formation, is shown on Plate 15. For outlining the area contaminated water is assumed arbitrarily to be indicated by a chloride content of 15 parts per million or more. Some wells outside the area shown as contaminated yielded water of a higher-than-normal chloride content, but other data indicated or suggested that these wells were being contaminated locally from the Patapsco formation or Pleistocene sediments through leaks in well casings; consequently, the area shown as contaminated was not extended to include such wells.

The map shows that the area of contamination covers practically all the Harbor district, a large part of the Canton district, and the southern part of the Highlandtown district, and extends south to the northernmost part of the Fairfield district.

The chloride content of the water from wells in the area of contamination, and of some of the wells outside, is shown in Plate 15. Water from well 2S1E-4 in the Harbor district has the highest chloride content, 5,350 parts per million, which is about as saline as the water in the nearby Patapsco River estuary.

Plate 16 shows the approximate areal extent of salt-water contamination in the water-bearing material that overlies the Arundel clay. This material consists chiefly of the Patapsco formation but includes sediments of Pleistocene age. The contaminated area includes large parts of the Canton, Dundalk, Fairfield, and Curtis Bay districts and practically all the Sparrows Point district. Again, a chloride content of 15 parts per million or more is considered arbitrarily as indicating contamination. As many wells ending in the Patapsco formation have been abandoned, it was not possible to obtain samples of water for chemical analysis from a large part of the area of contamination; for this reason the area shown is based to some extent on reported information. The chloride content of the water within the contaminated area has a wide range, as shown by symbols in Plate 16. Water in some parts of the contaminated area probably has a chloride content of as much as 4,000 to 5,000 parts per million, or about the same as that of water in the Patapsco River estuary. Chloride contents of more than 1,000 parts per million have been recorded for some wells in the Sparrows Point district.

CONTAMINATION BY INDUSTRIAL WASTES

Contamination of ground water by industrial wastes has been present in the Baltimore area for many years. Darton (1896, p. 143), who investigated the area about 1890 to 1895, reported that the soil at the old Baltimore Copper Co. plant in the Canton district was deeply saturated with acid, and that water from a well there probably was contaminated. Records of wells obtained in 1909 and 1916 (Clark, Mathews, and Berry, 1918, pp. 342-344) indicate that contamination of ground water by acid in the Harbor district was not uncommon at that time.

It was not possible to map the areal extent of the acid-contaminated ground water in the Baltimore area as most of the contaminated wells have been abandoned, preventing collection of water samples for chemical analysis. The major part of the acid contamination in the Canton district involves the water-bearing sands above the Arundel clay, but the Patuxent formation in that district also has been contaminated by leakage through wells.

Contamination by acid has been the principal cause in the abandonment of many wells in the Canton district; because of this, the pumping in the district is considerably less than formerly. During recent years the area of acid contamination has expanded northward to include some of the wells in the southern part of the Highlandtown district. A water sample collected on March 11, 1944, from well 2S4E-2, owned by the Crown Cork and Seal Co., had a total acidity of 161 parts per million (as H_2SO_4) and a pH of 3.6. A small steel file was placed in a sample of this water and bubbles of hydrogen were generated almost immediately. Other wells at this plant also yield water having a low pH, causing severe corrosion of well equipment and cooling-condenser tubes.

The source of the acid, which apparently is mostly sulfuric acid, cannot be attributed to any one locality. As acid plants and other industries in which acid is used in processing have been operated in the district during the past 100 years or more, it is likely that industrial wastes at several localities have caused the contamination. Moreover, as Geyer (1945, p. 11) points out, a part of the district has been used for dumping slag for many years, and natural oxidation of the sulfur in the slag produces sulfuric acid. In some parts of the district cast-iron water mains of the Baltimore public water supply had a maximum life of only 5 years; consequently elaborate protective measures have been employed to prevent rapid corrosion of the mains (Baltimore Department of Public Works, 1930, pp. 47-48).

Other industrial wastes also have caused local contamination of water-bearing formations. A sample of water collected on May 29, 1944, from well 2S1E-73, depth 30 feet, contained 664 parts per million of chromium. A plant in the Canton district is said to have considered drilling a water well years ago to recover the copper sulfate in the ground water contaminated by industrial wastes. About 35 dollars worth of copper could have been recovered from the water pumped during a day but as a well would not have lasted more than about 2 years in the corrosive water the proposal was not carried out.

Most of the contamination from industrial wastes is in the Canton and Harbor districts where salt water also has extensively contaminated the aquifers. The aquifers in other parts of the industrial area may be locally contaminated by industrial wastes, but it has not caused any appreciable change in quality of ground water pumped from the major well fields.

METHODS OF TESTING FOR SALT-WATER ENCROACHMENT

To determine whether the areas of contamination are spreading, a large number of samples of water were collected periodically from wells and field tests for chloride and pH were made. These data and chloride determinations made by industries are given in Table 14.

A long record of chloride determinations is of importance in determining the manner in which a well is being contaminated and whether the degree of contamination is increasing or decreasing. The chloride content may change appreciably within short periods of time (fig. 22); consequently, samples of water for chloride determination should be collected at least once a month from all wells in the industrial area that are equipped for pumping. In addition, it is advisable to collect samples for complete chemical analysis from active wells at least once a year.

GEOCHEMICAL ANALYSES

In the Baltimore area the chloride content of uncontaminated ground water probably ranges from about 1 to 15 parts per million; consequently, where the original content is low and contamination is so slight that the resulting content is less than about 15 parts per million, it may not be possible to determine from a single chloride analysis whether the ground water is contaminated. Geochemical studies of chemical analyses, however, reveal salt-water contamination where the chloride content has been increased by only a few parts per million.

Chemical analyses of water are generally expressed in parts per million as in Tables 13 and 14. The expression in parts per million, however, shows only the chemical composition of a water and not its chemical character, for the physical weight of a radical does not indicate its chemical value in a system of dissolved salts in water (Palmer, 1911, p. 7). In geochemical studies the analysis is converted to a basis that shows the reaction capacity, or reacting value of the ions or radicals. The reacting value of an ion may be determined by dividing the content, expressed in parts per million, by the equivalent combining weight of the ion; or by multiplying the amount in parts per million by the reciprocal of the equivalent combining weight, called the reaction coefficient.

The reaction coefficients of the radicals, most commonly present in ground water in the Baltimore area, are (Piper, 1945, p. 915):

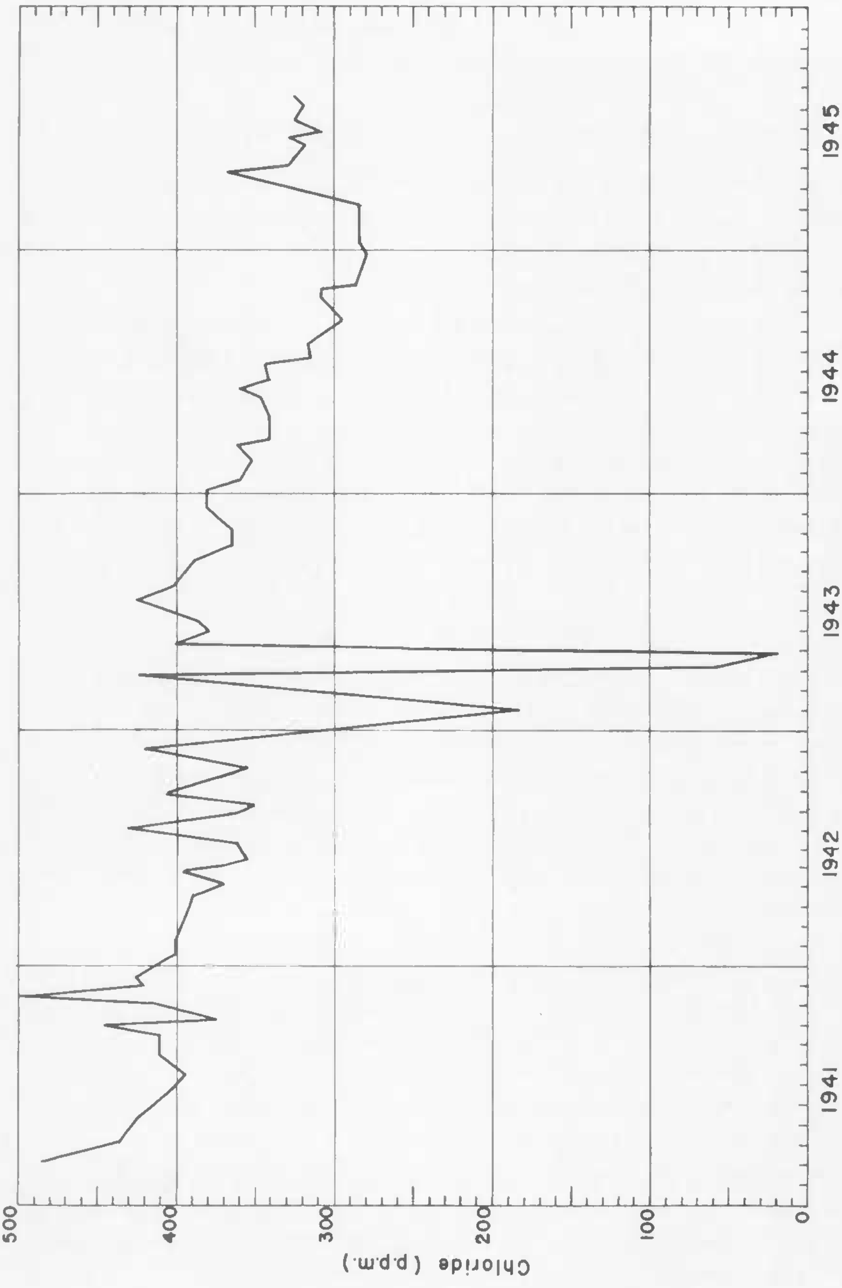


FIGURE 22. Graph showing fluctuations in chloride content of water from well 6S2E-9 in Curtis Bay district

TABLE 14
Chloride Content and pH of Water from Wells

Crystalline rocks

Well	Date	Cl	pH	Well	Date	Cl	pH
1S3E-1	-	89	6.8	3S1W-2	Feb. 8, 1944	370	7.4
2S1E-78	May 29, 1944	1,638	7.6	3S1W-3	Sept. 29, 1942	1,430	8.4
2S3E-6	May 25, 1943	315	7.6	Do	Feb. 8, 1944	1,730	7.5
2S3E-7	May 25, 1943	853	4.3	2N2E-1	1896	55.7	-
2S3W-4	Sept. 16, 1943	51	6.+	Bal-Fc 1	Oct. 19, 1943	14	-
3S1W-2	Sept. 29, 1942	300	7.4	Har-Dc 1	Aug. 9, 1944	5	7.3

Patuxent formation

Well	Date	Cl	pH	Well	Date	Cl	pH
1S3E-2	Oct. 2, 1942	53	4.7	3S4E-2	Oct. 2, 1942	36	5.0
Do	Apr. 3, 1943	24	-	Do	May 10, 1943	70	5.5
1S3E-3	Oct. 2, 1942	57	5.3	3S5E-1	Oct. 1, 1942	2	5.2
1S3E-4	Apr. 3, 1943	24	-	Do	1943	6	5.3
1S3E-5	Oct. 7, 1942	29	5.1	Do	May 4, 1943	8	-
Do	Sept. 10, 1943	38	4.9	3S5E-2	Oct. 1, 1942	3	5.4
1S3E-6	Oct. 7, 1942	9	5.2	Do	May 4, 1943	6	-
1S3E-6	Sept. 21, 1943	13	5.3	Do	Aug. 6, 1943	6	5.3
1S3E-7	Oct. 7, 1942	10	5.2	3S5E-8	Sept. 8, 1944	5	-
Do	Sept. 21, 1943	10	5.2	Do	Jan. 26, 1945	4	-
1S4E-1	Oct. 2, 1942	110	3.8-	3S5E-10	May 11, 1943	6	6.5
Do	Mar. 11, 1944	74	3.9	3S5E-11	Oct. 2, 1942	4	5.3
Do	do	55	5.0	Do	May 10, 1943	6	5.3
1S4E-2	Oct. 2, 1942	22	5.0	4S1E-1	Sept. 10, 1920	210	-
Do	Apr. 1, 1943	25	-	Do	Sept. 11, 1920	121	-
Do	Mar. 11, 1944	20	4.1	Do	Sept. 14, 1920	90	-
Do	do	24	5.3	Do	Nov. 1920	145	-
2S1E-1	July 1, 1943	2,230	6.1	Do	Nov. 6, 1942	4	5.9
Do	Apr. 5, 1944	3,200	-	Do	July 15, 1943	3	5.4
2S1E-2	July 1, 1943	1,245	5.9	Do	Sept. 10, 1943	9	5.5
Do	Apr. 5, 1944	1,140	-	Do	Jan. 8, 1944	10	-
2S1E-4	Sept. 21, 1943	5,354	6.+	Do	Jan. 29, 1944	12	-
2S1E-5	Sept. 21, 1943	2,458	6.+	4S2E-1	1931	3	-
2S1E-16	Mar. 28, 1944	234	6.1	Do	June 1940	159	-
2S2E-1	July 2, 1943	4,350	6.9	Do	Oct. 3, 1942	590	4.8
2S2E-2	-	520	-	4S2E-2	1940	175	-
2S2E-3	-	82	-	Do	Jan. 1941	215	-
2S2E-4	-	290	-	Do	Sept. 26, 1941	319	-
2S2E-5	-	160	-	Do	July 15, 1943	710	4.9
2S3E-8	May 25, 1943	955	5.5	4S2E-3	1920	10	-
2S3E-9	-	200	-	4S3E-1	1920	36.6	-
2S3E-10	-	430	-	Do	1940	13.5	-
2S3E-11	-	1,268	-	4S3E-1	Nov. 6, 1942	8	5.7
2S3E-17	Mar. 2, 1941	312	5.2	Do	July 23, 1943	18	5.3
2S4E-1	May 15, 1943	36	5.1	4S3E-2	Dec. 1920	23.7	-
2S4E-2	Apr. 1, 1943	150	-	4S3E-3	Aug. 30, 1943	44	5.2
Do	Mar. 11, 1944	172	4.5	Do	Oct. 15, 1945	40	-
Do	do	180	3.6	4S3E-6	1920	5.6	-
3S1E-1	July 1, 1943	3,670	6.5	4S3E-7	1920	23.7	-
Do	Feb. 5, 1945	2,490	-	4S3E-8	1920	22.4	-
3S1E-2	Apr. 5, 1944	956	-	5S2E-1	Nov. 6, 1942	4.5	5.5
3S3E-1	Sept. 30, 1942	-	5.2	Do	July 31, 1943	7	5.2
Do	May 4, 1943	135	-	5S3E-1	Aug. 3, 1943	53	4.8
Do	Apr. 5, 1944	700	-	5S3E-12	Aug. 1939	9	5.0
3S4E-1	Oct. 1, 1942	2	5.4	5S3E-17	1920	11.2	-
Do	May 28, 1943	3	5.4	5S3E-21	Nov. 6, 1942	23	6.0

TABLE 14—*Continued*

Patuxent formation—*Continued*

Well	Date	Cl	pH	Well	Date	Cl	pH
5S3E-21	Sept. 13, 1943	33	5.9	6S2E-2	Mar. 25, 1941	17	5.0
5S3E-22	May 14, 1903	0.8	-	Do	May 7, 1941	10	4.7
5S3E-36	Nov. 6, 1942	117	4.9	Do	Oct. 29, 1941	5	4.6
Do	Mar. 2, 1944	182	5.1	Do	Mar. 5, 1942	4	4.8
5S3E-37	Nov. 6, 1942	280	4.8	6S2E-3	Jan. 11, 1939	97	4.0
5S3E-38	Nov. 6, 1942	79	5.0	Do	Mar. 21, 1939	100	4.2
Do	Mar. 2, 1944	101	5.1	Do	July 11, 1939	100	4.3
5S3E-42	1920	6.9	-	Do	Oct. 31, 1939	96	4.6
6S2E-1	June 18, 1942	4	4.9	Do	Jan. 4, 1940	90	4.4
Do	Nov. 5, 1942	4	4.6	Do	May 1, 1940	90	4.5
Do	Feb. 9, 1943	4	5.0	Do	Aug. 3, 1940	84	4.0
Do	May 29, 1943	3	5.2	Do	Jan. 8, 1941	76	4.2
Do	Aug. 13, 1943	4	5.1	Do	Apr. 1, 1941	84	4.3
Do	Aug. 19, 1943	5	4.8	Do	May 19, 1941	79	4.4
Do	Sept. 2, 1943	6	5.7	Do	Oct. 2, 1941	73	4.2
Do	Sept. 10, 1943	5	5.1	Do	Feb. 25, 1942	49	4.0
Do	Oct. 8, 1943	4	4.9	Do	Mar. 5, 1942	65	4.0
Do	Nov. 5, 1943	3	5.0	Do	July 21, 1942	56	4.3
Do	Dec. 10, 1943	3	5.2	Do	Dec. 9, 1942	50	4.0
Do	Jan. 5, 1944	2	-	Do	Mar. 4, 1943	10	4.2
Do	Jan. 22, 1944	4	5.1	Do	Mar. 11, 1943	43	4.4
Do	Jan. 29, 1944	2	-	Do	May 29, 1943	40	4.8
Do	Feb. 19, 1944	4	-	Do	Oct. 12, 1944	31	-
Do	Mar. 4, 1944	5	5.3	Do	Oct. 19, 1944	35	-
Do	Mar. 11, 1944	4	-	Do	Oct. 26, 1944	23	5.1
Do	Mar. 18, 1944	4	-	Do	Nov. 2, 1944	28	-
Do	Apr. 8, 1944	3	-	Do	Nov. 9, 1944	26	-
Do	Apr. 22, 1944	3	-	Do	Nov. 16, 1944	26	-
Do	May 13, 1944	3	-	Do	Nov. 30, 1944	26	-
Do	May 20, 1944	3	-	Do	Dec. 22, 1944	25	-
Do	May 27, 1944	4	-	Do	Dec. 29, 1944	26	-
Do	June 3, 1944	3	-	6S2E-4	June 22, 1939	4	6.0
Do	June 10, 1944	5	-	Do	July 31, 1939	6	5.0
Do	June 17, 1944	3	-	Do	Aug. 29, 1939	13	5.5
Do	June 23, 1944	4	-	Do	Jan. 4, 1940	19	5.0
Do	July 3, 1944	6	-	Do	Apr. 2, 1940	26	4.7
Do	July 14, 1944	5	-	Do	July 9, 1940	40	4.6
Do	July 21, 1944	4	-	Do	Oct. 2, 1940	59	4.5
Do	July 28, 1944	4	-	Do	Jan. 8, 1941	76	4.3
Do	Aug. 4, 1944	4	-	Do	May 7, 1941	68	4.5
Do	Aug. 11, 1944	4	-	Do	Sept. 11, 1941	62	4.8
Do	Aug. 18, 1944	3	-	Do	Jan. 14, 1942	57	4.3
Do	Aug. 25, 1944	3	-	Do	June 2, 1942	48	4.2
Do	Sept. 8, 1944	3	-	Do	Oct. 8, 1942	39	4.5
Do	Oct. 5, 1944	3	-	Do	Jan. 21, 1943	22	4.1
Do	Oct. 19, 1944	3	-	Do	Mar. 19, 1943	42	5.1
Do	Oct. 26, 1944	3	-	Do	May 29, 1943	39	5.1
Do	Nov. 2, 1944	3	-	Do	Aug. 13, 1943	46	4.9
Do	Nov. 9, 1944	2	-	Do	Aug. 19, 1943	46	4.8
Do	Nov. 16, 1944	3	-	Do	Aug. 26, 1943	44	4.7
Do	Nov. 30, 1944	2	-	Do	Sept. 2, 1943	23	4.9
Do	Dec. 22, 1944	2	-	Do	Sept. 10, 1943	45	4.9
Do	Dec. 29, 1944	2	-	Do	Oct. 8, 1943	43	4.8
6S2E-2	Jan. 9, 1939	3	5.6	Do	Nov. 5, 1943	44	4.8
Do	July 11, 1939	3	5.3	Do	Dec. 10, 1943	44	5.0
Do	Dec. 5, 1939	3	5.3	Do	Oct. 5, 1944	8	-
Do	Aug. 13, 1940	4	4.8	Do	Oct. 12, 1944	7	-
Do	Nov. 13, 1940	8	4.9	Do	Oct. 19, 1944	12	-
Do	Mar. 12, 1941	26	4.7	Do	Oct. 26, 1944	13	6.0

TABLE 14—*Continued*

Patuxent formation—*Continued*

Well	Date	Cl	pH	Well	Date	Cl	pH
6S2E-4	Nov. 2, 1944	15	-	6S2E-9	May 7, 1941	435	4.1
Do	Nov. 9, 1944	14	-	Do	July 16, 1941	395	4.2
Do	Nov. 16, 1944	18	-	Do	Oct. 2, 1941	445	4.0
Do	Nov. 23, 1944	20	-	Do	Nov. 19, 1941	500	4.1
Do	Nov. 30, 1944	22	-	Do	Jan. 21, 1942	400	4.2
Do	Dec. 22, 1944	24	-	Do	Apr. 22, 1942	390	3.8
Do	Dec. 29, 1944	25	-	Do	July 1, 1942	340	4.3
6S2E-5	Jan. 11, 1939	57	4.1	Do	Oct. 8, 1942	395	4.1
Do	May 2, 1939	62	4.6	Do	Dec. 9, 1942	420	4.2
Do	July 11, 1939	65	4.5	Do	Feb. 9, 1943	180	4.1
Do	Aug. 9, 1939	155	3.9	Do	Apr. 8, 1943	60	5.7
Do	Aug. 16, 1939	75	4.3	Do	May 29, 1943	358	4.5
Do	Oct. 10, 1939	60	4.6	Do	Aug. 13, 1943	400	4.2
Do	Jan. 4, 1940	63	4.4	Do	Aug. 19, 1943	393	4.2
Do	Mar. 6, 1940	78	4.2	Do	Aug. 26, 1943	400	4.2
Do	Apr. 16, 1940	90	4.6	Do	Sept. 2, 1943	396	4.2
Do	July 30, 1940	119	4.5	Do	Sept. 10, 1943	390	4.3
Do	Sept. 11, 1940	126	4.3	Do	Oct. 8, 1943	365	4.2
6S2E-7	Jan. 11, 1939	92	4.1	Do	Nov. 5, 1943	365	4.3
Do	Mar. 2, 1939	110	4.3	Do	Dec. 10, 1943	380	4.2
Do	Apr. 4, 1939	80	4.2	Do	Jan. 5, 1944	379	-
Do	June 20, 1939	75	4.1	Do	Jan. 22, 1944	372	4.2
Do	Sept. 12, 1939	75	4.3	Do	Jan. 29, 1944	364	-
Do	Nov. 21, 1939	77	4.3	Do	Feb. 19, 1944	352	-
Do	Jan. 31, 1940	80	4.2	Do	Mar. 4, 1944	366	4.7
Do	Apr. 2, 1940	74	4.4	Do	Mar. 11, 1944	362	-
Do	Aug. 13, 1940	70	4.1	Do	Mar. 18, 1944	340	-
Do	Dec. 5, 1940	66	4.4	Do	Apr. 8, 1944	346	-
Do	May 7, 1941	51	4.2	Do	Apr. 22, 1944	342	-
Do	Oct. 2, 1941	41	4.3	Do	May 13, 1944	345	-
Do	Feb. 25, 1942	26	4.0	Do	May 20, 1944	346	-
Do	Sept. 16, 1942	18	4.5	Do	May 27, 1944	345	-
Do	Jan. 8, 1943	19	4.5	Do	June 3, 1944	360	-
Do	May 29, 1943	28	5.1	Do	June 10, 1944	350	-
Do	Aug. 19, 1943	6	5.2	Do	June 17, 1944	344	-
Do	Aug. 26, 1943	14	5.3	Do	June 23, 1944	342	-
Do	Sept. 2, 1943	18	5.1	Do	July 3, 1944	344	-
Do	Sept. 10, 1943	17	5.1	Do	July 7, 1944	342	-
Do	Oct. 8, 1943	19	4.9	Do	July 14, 1944	320	-
Do	Nov. 5, 1943	15	4.9	Do	July 21, 1944	316	-
Do	Dec. 10, 1943	14	5.1	Do	July 28, 1944	320	-
Do	Jan. 8, 1944	10	-	Do	Aug. 4, 1944	321	-
Do	Jan. 22, 1944	11	5.3	Do	Aug. 11, 1944	318	4.4
Do	Jan. 29, 1944	3	-	Do	Aug. 18, 1944	313	-
Do	July 7, 1944	6	-	Do	Aug. 25, 1944	310	4.2
Do	Aug. 25, 1944	8	5.2	Do	Sept. 8, 1944	310	-
Do	Sept. 8, 1944	12	-	Do	Sept. 15, 1944	296	-
Do	Oct. 5, 1944	16	-	Do	Oct. 12, 1944	311	-
Do	Oct. 12, 1944	12	-	Do	Oct. 19, 1944	308	-
Do	Oct. 19, 1944	12	-	Do	Nov. 2, 1944	308	-
Do	Oct. 26, 1944	10	5.3	Do	Nov. 9, 1944	287	-
Do	Nov. 2, 1944	8	-	Do	Nov. 30, 1944	285	-
Do	Nov. 9, 1944	6	-	Do	Dec. 29, 1944	280	-
Do	Nov. 16, 1944	4	-	6S2E-11	May 1935	12	-
Do	Nov. 30, 1944	7	-	Do	Oct. 1935	174	-
Do	Dec. 22, 1944	6	-	6S2E-13	May 1935	12	-
Do	Dec. 29, 1944	6	-	Do	Oct. 1935	69	-
6S2E-9	Oct. 18, 1940	460	4.0	6S2E-29	Aug. 27, 1943	107	5.1
Do	Mar. 4, 1941	485	4.3	6S2E-30	Nov. 13, 1942	100	4.8

TABLE 14—*Continued*

Patuxent formation--*Continued*

Well	Date	Cl	pH	Well	Date	Cl	pH
6S2E-31	Aug. 27, 1943	4	4.7	Bal-Gf 3	Nov. 15, 1943	25	-
6S2E-32	Nov. 13, 1942	253	4.1	Do	Nov. 19, 1943	28	-
Do	Aug. 27, 1943	350	4.1	Do	Dec. 9, 1943	30	-
6S2E-37	1920	6.9	-	Do	Dec. 17, 1943	30	-
6S2E-38	1920	153.3	-	Bal-Gf 4	Apr. 26, 1941	9	-
6S3E-1	May 28, 1942	121	-	Do	Sept. 24, 1941	18	-
Do	do	312	-	Do	Oct. 1, 1941	18	-
Do	Aug. 3, 1942	151	-	Do	June 1, 1942	8	-
Do	Aug. 7, 1942	250	-	Do	Nov. 1, 1942	11	-
Do	Aug. 13, 1943	268	5.1	Do	May 10, 1943	10	6.8
Do	do	197	5.7	Bal-Gf 5	Aug. 19, 1940	31	-
6S3E-6	Nov. 13, 1942	277	5.7	Do	Apr. 27, 1941	33	-
6S3E-7	May 28, 1942	4	-	Do	Sept. 24, 1941	29	-
Do	do	9	-	Do	Mar. 18, 1943	70	-
Do	Nov. 13, 1942	2	6.0	Do	do	1,300	-
Do	Aug. 13, 1943	4	6.5	Do	June 29, 1943	27	-
6S3E-8	May 28, 1942	31	-	Do	Oct. 15, 1943	40	-
Do	do	142	-	Do	Oct. 22, 1943	40	-
Do	Aug. 3, 1942	64	-	Do	Oct. 29, 1943	40	-
Do	Aug. 7, 1942	64	-	Do	Nov. 13, 1943	40	-
Do	Nov. 13, 1942	60	4.2	Do	Nov. 15, 1943	45	-
Do	Aug. 13, 1943	92	5.5	Do	Dec. 9, 1943	40	-
7S3E-1	1920	7.3	-	Do	Dec. 17, 1943	40	-
Do	Aug. 13, 1943	5	4.7	Bal-Gf 6	Mar. 9, 1936	14	6.6
7S3E-4	Apr. 1919	6	-	Do	Dec. 2, 1940	8	6.3
3S1W-6	Sept. 9, 1944	12	-	Do	Jan. 14, 1941	9.5	-
AA-Ad 7	Aug. 2, 1943	4	5.0	Do	Feb. 1941	50	-
Do	Aug. 19, 1943	4	5.0	Do	do	61	-
AA-Ad 8	1920	5.8	-	Do	Apr. 27, 1941	47.5	-
AA-Ae 1	Aug. 24, 1943	5	5.3	Do	Sept. 24, 1941	34	-
Bal-Fe 1	Oct. 7, 1942	6	5.2	Do	Oct. 1, 1941	16	-
Bal-Fe 2	May 3, 1943	10	-	Do	June 1, 1942	10	-
Bal-Fe 4	May 3, 1943	5	-	Do	do	46	-
Bal-Fe 11	Oct. 7, 1942	6	5.0	Do	Nov. 1, 1942	133	-
Bal-Fe 15	Feb. 26, 1941	5.5	-	Do	May 10, 1943	142	5.9
Bal-Fe 17	May 4, 1943	6	-	Bal-Gf 8	Apr. 27, 1941	9.5	-
Bal-Gc 3	Aug. 10, 1944	10	5.4	Do	Sept. 24, 1941	12	-
Bal-Ge 2	June 30, 1943	20	6.1	Do	June 1, 1942	11	-
Bal-Gf 3	Nov. 23, 1940	23	6.3	Do	Nov. 1, 1942	13	-
Do	Apr. 26, 1941	15	-	Do	Apr. 9, 1943	14	-
Do	Apr. 27, 1941	25	-	Do	May 10, 1943	30	5.9
Do	Sept. 24, 1941	30	-	Do	June 15, 1943	20	-
Do	Oct. 1, 1941	30	-	Do	June 29, 1943	25	-
Do	June 1, 1942	28	-	Do	July 5, 1943	25	-
Do	Nov. 1, 1942	41.5	-	Do	July 12, 1943	25	-
Do	June 15, 1943	25	-	Do	July 20, 1943	25	-
Do	June 29, 1943	30	-	Do	July 26, 1943	20	5.9
Do	July 5, 1943	30	-	Do	Aug. 4, 1943	20	5.9
Do	July 12, 1943	30	-	Do	Aug. 10, 1943	22	6.0
Do	July 20, 1943	25	-	Do	Aug. 17, 1943	25	-
Do	July 26, 1943	30	-	Do	Aug. 18, 1943	21	5.9
Do	Aug. 17, 1943	35	-	Do	Aug. 24, 1943	20	5.9
Do	Aug. 24, 1943	30	-	Do	Aug. 30, 1943	25	-
Do	Aug. 30, 1943	25	-	Do	Sept. 1, 1943	19	6.0
Do	Sept. 7, 1943	30	-	Do	Sept. 7, 1943	25	-
Do	Oct. 15, 1943	35	-	Do	Sept. 8, 1943	19	5.9
Do	Oct. 22, 1943	35	-	Do	Oct. 7, 1943	13	5.9
Do	Oct. 29, 1943	40	-	Do	Oct. 15, 1943	20	-
Do	Nov. 13, 1943	25	-	Do	Oct. 22, 1943	20	-

TABLE 14—*Continued*

Patuxent formation—*Continued*

Well	Date	Cl	pH	Well	Date	Cl	pH
Bal-Gf 8	Oct. 29, 1943	15	-	Bal-Gf 11	July 5, 1943	30	-
Do	Nov. 4, 1943	13	6.2	Do	July 12, 1943	25	-
Do	Nov. 15, 1943	15	-	Do	July 20, 1943	30	-
Do	Dec. 9, 1943	14	5.9	Do	July 26, 1943	25	-
Do	Dec. 17, 1943	15	-	Do	Aug. 17, 1943	30	-
Do	Jan. 8, 1944	14	-	Do	Aug. 24, 1943	25	-
Do	Feb. 5, 1944	18	-	Do	Aug. 30, 1943	25	-
Do	Mar. 11, 1944	18	-	Do	Sept. 7, 1943	20	-
Do	Apr. 15, 1944	19	-	Do	Oct. 15, 1943	30	-
Do	May 9, 1944	18	6.0	Do	Oct. 22, 1943	45	-
Do	June 13, 1944	20	6.2	Do	Oct. 29, 1943	45	-
Do	July 3, 1944	18	6.1	Do	Nov. 13, 1943	35	-
Bal-Gf 9	Aug. 19, 1940	9	-	Do	Nov. 15, 1943	40	-
Do	Nov. 23, 1940	10	6.0	Do	Nov. 20, 1943	17	-
Do	Apr. 27, 1941	12	-	Do	do	33	-
Do	Sept. 24, 1941	20	-	Do	Dec. 9, 1943	30	-
Do	Oct. 1, 1941	20	-	Do	Dec. 17, 1943	30	-
Do	June 1942	14	-	Bal-Gf 12	May 12, 1943	55	5.9
Do	Nov. 1, 1942	13.5	-	Do	May 14, 1943	9	5.9
Do	Apr. 9, 1943	8	-	Bal-Gf 16	May 12, 1943	12	6.1
Do	May 10, 1943	10	5.9	Do	May 14, 1943	10	5.9
Do	June 15, 1943	10	-	Bal-Gf 32	Sept. 15, 1937	-	6.3
Do	July 5, 1943	10	-	Do	Nov. 27, 1940	11.5	6.0
Do	July 12, 1943	10	-	Do	Apr. 27, 1941	9	-
Do	July 20, 1943	10	-	Do	Oct. 1, 1941	10	-
Do	July 26, 1943	10	-	Do	May 1, 1942	12	-
Do	Aug. 4, 1943	10	5.5	Do	Nov. 1, 1942	12	-
Do	Aug. 11, 1943	10	5.9	Do	Mar. 11, 1943	15	-
Do	Aug. 17, 1943	15	-	Do	do	63	-
Do	Aug. 18, 1943	11	6.9	Do	Mar. 14, 1943	16	-
Do	Aug. 24, 1943	10	5.9	Do	May 11, 1943	15	6.1
Do	Aug. 30, 1943	10	-	Do	July 26, 1943	17	6.3
Do	Sept. 1, 1943	10	6.1	Do	Aug. 4, 1943	16	5.7
Do	Sept. 7, 1943	15	-	Do	Aug. 18, 1943	13	5.7
Do	Sept. 8, 1943	9	5.4	Do	Aug. 24, 1943	13	5.7
Do	Oct. 7, 1943	10	5.5	Do	Sept. 1, 1943	13	5.8
Do	Oct. 15, 1943	15	-	Do	Sept. 7, 1943	14	6.1
Do	Oct. 22, 1943	15	-	Do	Oct. 8, 1943	10	6.0
Do	Oct. 29, 1943	20	-	Do	Nov. 3, 1943	11	6.0
Do	Nov. 4, 1943	9	6.0	Do	Dec. 10, 1943	12	5.9
Do	Nov. 13, 1943	10	-	Do	Jan. 8, 1944	11	-
Do	Nov. 15, 1943	15	-	Do	Mar. 11, 1944	11	-
Do	Dec. 9, 1943	8	5.8	Bal-Gf 35	Dec. 15, 1937	-	6.3
Do	Dec. 17, 1943	15	-	Do	Apr. 27, 1941	12	-
Do	Jan. 8, 1944	8	-	Do	Oct. 1, 1941	10	-
Do	Feb. 5, 1944	8	-	Do	May 1, 1942	14	-
Do	Mar. 11, 1944	10	-	Do	May 11, 1943	15	6.2
Do	Apr. 15, 1944	11	-	Do	July 16, 1943	15	6.1
Do	Apr. 27, 1944	12	-	Do	July 26, 1943	17	6.1
Do	May 9, 1944	9	5.9	Do	Aug. 4, 1943	17	6.0
Do	June 13, 1944	10	5.7	Do	Aug. 11, 1943	14	5.9
Do	July 13, 1944	6	5.9	Do	Aug. 18, 1943	13	6.0
Bal-Gf 11	Sept. 24, 1941	24	-	Do	Aug. 24, 1943	11	6.0
Do	Oct. 1, 1941	24	-	Do	Sept. 1, 1943	12	5.9
Do	June 1, 1942	26	-	Do	Sept. 7, 1943	12	6.1
Do	Nov. 1, 1942	28	-	Do	Apr. 15, 1944	10	-
Do	May 10, 1943	21	5.9	Bal-Gf 36	Dec. 1937	11	6.0
Do	June 15, 1943	25	-	Do	Oct. 27, 1940	-	6.1
Do	June 29, 1943	25	-	Do	Apr. 27, 1941	10	-

TABLE 14—*Continued*

Patuxent formation—*Continued*

Well	Date	Cl	pH	Well	Date	Cl	pH
Bal-Gf 36	Oct. 1, 1941	12	-	Bal-Gf 93	Mar. 16, 1944	46	-
Do	May 1, 1942	12	-	Do	Mar. 17, 1944	50	-
Do	Jan. 1943	26	-	Do	Mar. 20, 1944	200	-
Do	May 11, 1943	50	5.9	Do	Mar. 21, 1944	200	-
Do	Oct. 5, 1943	14	6.0	Do	Mar. 27, 1944	175	-
Do	Oct. 8, 1943	10	6.0	Do	Mar. 28, 1944	170	-
Do	Dec. 10, 1943	10	6.0	Do	Mar. 31, 1944	175	-
Bal-Gf 47	Mar. 9, 1936	10.5	6.8	Do	May 9, 1944	115	6.1
Do	Feb. 27, 1941	7	-	Do	May 24, 1944	42.2	-
Do	Sept. 1, 1941	24	-	Do	May 31, 1944	46	-
Do	June 1, 1942	7	-	Do	June 7, 1944	95	-
Do	Jan. 1943	8	-	Do	July 12, 1944	49	-
Bal-Gf 48	Mar. 9, 1936	8.7	6.6	Do	July 13, 1944	56	-
Do	Dec. 2, 1940	6.0	6.7	Do	Sept. 1, 1944	11.5	-
Do	Feb. 27, 1941	7	-	Bal-Gf 95	Oct. 20, 1940	6.5	6.7
Do	Sept. 1, 1941	20	-	Do	Oct. 1, 1941	9	-
Do	June 1, 1942	63	-	Do	June 1, 1942	10	-
Do	Jan. 1943	23	-	Do	May 20, 1943	9	-
Bal-Gf 49	Dec. 2, 1940	7.5	6.3	Bal-Gf 105	Nov. 28, 1935	14	-
Do	Feb. 27, 1941	7	-	Do	Nov. 20, 1940	6.5	6.1
Bal-Gf 51	Mar. 9, 1936	10.5	6.6	Do	Oct. 1, 1941	7.5	-
Do	Feb. 27, 1941	6.5	-	Do	Apr. 1942	6.0	-
Do	Sept. 1, 1941	38	-	Do	May 20, 1943	6.5	5.4
Do	June 1, 1942	71	-	Do	July 26, 1943	8	5.7
Bal-Gf 52	Mar. 9, 1936	14	6.6	Do	Aug. 11, 1943	7	5.9
Do	Dec. 2, 1940	8.5	6.3	Do	Aug. 13, 1943	9	-
Do	Feb. 27, 1941	9.5	-	Do	Aug. 18, 1943	7	5.5
Do	Sept. 1, 1941	17	-	Do	Aug. 24, 1943	6	5.9
Do	June 1, 1942	12	-	Do	Sept. 1, 1943	6	5.9
Do	Feb. 3, 1944	16	-	Do	Sept. 7, 1943	7	6.3
Bal-Gf 53	Sept. 1941	41	-	Do	Oct. 7, 1943	6	5.7
Do	Jan. 1943	8	-	Do	Nov. 3, 1943	6	6.0
Bal-Gf 78[a]	Apr. 28, 1938	8.5	-	Do	Dec. 9, 1943	7	6.0
Do	Nov. 20, 1940	7.5	6.3	Do	Jan. 8, 1944	6	-
Do	Oct. 1, 1941	14	-	Do	Feb. 5, 1944	8	-
Do	May 20, 1943	9	5.4	Do	May 9, 1944	6	6.0
Do	Aug. 4, 1943	11	6.0	Do	June 13, 1944	6	6.0
Do	Sept. 7, 1943	9	6.3	Do	July 13, 1944	6	6.1
Do	Oct. 7, 1943	8	5.9	Bal-Gf 136	Jan. 20, 1931	28.2	-
Do	Nov. 4, 1943	8	6.1	Do	Apr. 8, 1931	12.3	-
Do	Dec. 9, 1943	8	5.7	Do	June 15, 1931	10.6	-
Do	Jan. 8, 1944	8	-	Do	Oct. 14, 1931	7.2	-
Do	Feb. 5, 1944	8	-	Do	May 31, 1937	106	-
Bal-Gf 93	Nov. 28, 1935	17.7	-	Do	June 28, 1937	14.1	-
Do	Nov. 20, 1940	6.5	-	Do	May 19, 1938	14.1	-
Do	Oct. 1, 1941	20	-	Do	July 28, 1938	7.2	-
Do	June 1, 1942	6.5	-	Do	Aug. 6, 1938	14.1	-
Do	May 20, 1943	1.5	5.3	Do	Sept. 30, 1938	3.5	-
Do	Nov. 24, 1943	126	-	Do	Oct. 10, 1938	7.2	-
Do	Nov. 25, 1943	67	-	Do	Apr. 17, 1939	7.2	-
Do	Dec. 9, 1943	38	6.0	Do	Apr. 21, 1939	10.6	-
Do	Dec. 21, 1943	40	-	Do	May 15, 1939	10.6	-
Do	Mar. 6, 1944	1,625	-	Do	June 22, 1939	14.2	-
Do	do	60	-	Do	July 10, 1939	10.6	-
Do	Mar. 10, 1944	30	-	Do	Aug. 4, 1939	14.2	-
Do	Mar. 12, 1944	50	-	Do	Aug. 17, 1939	7.2	-
Do	Mar. 13, 1944	44	-	Do	Sept. 18, 1939	10.6	-
Do	Mar. 14, 1944	46	-	Do	Nov. 13, 1939	10.6	-
Do	Mar. 15, 1944	46	-	Do	Dec. 28, 1939	10.6	-

TABLE 14—*Continued*

Patuxent formation—*Continued*

Well	Date	Cl	pH	Well	Date	Cl	pH
Bal-Gf 136	Feb. 5, 1940	10.6	-	Bal-Gf 139	Feb. 12, 1940	10.6	-
Do	Mar. 11, 1940	7.2	-	Do	Mar. 14, 1940	7.1	-
Do	Apr. 15, 1940	14.2	-	Do	Apr. 4, 1940	14.1	-
Do	May 13, 1940	10.6	-	Do	May 16, 1940	7.1	-
Do	June 27, 1940	10.6	-	Do	June 25, 1940	10.6	-
Do	Aug. 8, 1940	10.6	-	Do	Aug. 15, 1940	10.6	-
Do	Sept. 5, 1940	7.2	-	Do	Sept. 19, 1940	10.6	-
Do	Sept. 26, 1940	10.6	-	Do	Oct. 17, 1940	7.1	-
Do	Oct. 17, 1940	14.2	-	Do	Dec. 2, 1940	10.6	-
Do	Dec. 2, 1940	10.6	-	Do	June 15, 1943	12	-
Bal-Gf 139	Mar. 6, 1939	10.6	-	Do	June 16, 1943	5	-
Do	Mar. 16, 1939	14.1	-	Do	June 17, 1943	17	-
Do	Mar. 30, 1939	8.9	-	Do	June 18, 1943	20	-
Do	Apr. 10, 1939	7.1	-	Do	June 20, 1943	8	-
Do	Apr. 18, 1939	10.6	-	Do	June 28, 1943	9	-
Do	Apr. 27, 1939	8.9	-	Do	June 30, 1943	4.5	-
Do	May 18, 1939	10.6	-	Do	July 4, 1943	8.5	-
Do	June 22, 1939	14.1	-	Do	July 8, 1943	9	-
Do	July 31, 1939	10.6	-	Do	July 12, 1943	10	-
Do	Aug. 29, 1939	10.6	-	Do	Aug. 12, 1943	8	-
Do	Sept. 28, 1939	10.6	-	Do	Aug. 13, 1943	5	-
Do	Oct. 16, 1939	8.9	-	Do	Aug. 15, 1943	10	-
Do	Nov. 17, 1939	10.6	-	Do	Dec. 9, 1943	7	6.0
Do	Dec. 25, 1939	10.6	-	Do	Feb. 4, 1944	8	-
Do	Jan. 8, 1940	12.4	-	Har-Ed 15[a]	Apr. 13, 1944	-	5.3

Patapsco formation

Well	Date	Cl	pH	Well	Date	Cl	pH
2S4E-3	July 21, 1943	19	5.7	6S2E-10	Jan. 15, 1944	62	-
3S5E-6	Feb. 15, 1945	124	-	Do	Jan. 22, 1944	56	5.2
Do	Mar. 19, 1945	96	-	Do	Jan. 29, 1944	50	-
3S5E-7	Jan. 26, 1945	74	-	Do	Feb. 19, 1944	70	-
Do	Feb. 15, 1945	50	-	Do	Mar. 4, 1944	62	5.3
Do	Mar. 19, 1945	64	-	Do	Mar. 11, 1944	64	-
3S5E-9	Feb. 15, 1945	132	-	Do	Mar. 18, 1944	62	-
Do	Mar. 26, 1945	24	-	Do	Apr. 8, 1944	68	-
Do	Apr. 27, 1945	91	-	Do	Apr. 22, 1944	68	-
3S5E-19	July 29, 1914	83.4	-	Do	May 13, 1944	72	-
6S2E-10	Sept. 14, 1932	30	4.6	Do	May 20, 1944	71	-
Do	Jan. 9, 1939	234	3.8	Do	May 27, 1944	73	-
Do	Mar. 14, 1939	270	3.8	Do	June 3, 1944	70	-
Do	May 2, 1939	240	3.9	Do	June 17, 1944	70	-
Do	July 11, 1939	230	3.6	Do	June 23, 1944	70	-
Do	May 7, 1941	163	4.3	Do	July 3, 1944	72	-
Do	May 19, 1941	23	4.4	Do	July 7, 1944	72	-
Do	July 2, 1941	20	4.7	Do	July 21, 1944	62	-
Do	Aug. 8, 1941	30	4.6	Do	Aug. 11, 1944	50	5.5
Do	Oct. 2, 1941	37	4.1	Do	Aug. 18, 1944	59	-
Do	Dec. 10, 1941	30	4.4	Do	Aug. 25, 1944	64	5.2
Do	Mar. 5, 1942	32	4.4	Do	Sept. 8, 1944	66	-
Do	June 18, 1942	31	4.7	Do	Sept. 9, 1944	43	5.1
Do	Aug. 26, 1942	41	4.5	Do	do	92	3.8
Do	Sept. 14, 1942	30	4.6	Do	Sept. 15, 1944	67	-
Do	May 29, 1943	31	4.9	Do	Nov. 30, 1944	32	-
Do	Nov. 5, 1943	54	5.0	Do	Dec. 22, 1944	34	-
Do	Dec. 10, 1943	57	5.1	Do	Dec. 29, 1944	44	-

TABLE 14—*Continued*

Patapsco formation—*Continued*

Well	Date	Cl	pH	Well	Date	Cl	pH
6S4E-1	Feb. 1941	10	-	Bal-Gf 29	Mar. 11, 1944	535	-
Do	Sept. 14, 1943	948	4.2	Do	Mar. 23, 1944	500	-
7S3E-2	Aug. 13, 1943	8	5.5	Do	Mar. 31, 1944	485	-
AA-Ad 1	June 21, 1943	4	5.2	Do	Apr. 9, 1944	463	-
AA-Ad 2	June 21, 1943	4	5.1	Do	Apr. 14, 1944	455	-
AA-Ad 3	June 21, 1943	8	5.1	Bal-Gf 30	Dec. 15, 1937	-	6.1
AA-Ad 4	Mar. 21, 1919	3	-	Do	Jan. 6, 1938	4.0	-
Do	Aug. 2, 1943	7	5.7	Do	Nov. 27, 1940	8.5	-
Do	Aug. 19, 1943	8	5.5	Do	Apr. 26, 1941	9	-
AA-Ad 5	Aug. 2, 1943	17	5.9	Do	Oct. 1, 1941	12	-
AA-Ad 6	Aug. 2, 1943	9	5.5	Do	May 1, 1942	12	-
Do	Aug. 19, 1943	8	5.7	Do	Nov. 1, 1942	10	-
AA-Ad 9	1920	4.7	-	Do	May 11, 1943	20	5.7
AA-Ad 10	1920	5.4	-	Do	May 9, 1944	18	5.7
AA-Ae 2	Aug. 26, 1943	18	5.5	Do	June 13, 1944	14	5.6
AA-Ae 3	Aug. 26, 1943	21	6.1	Bal-Gf 31	Dec. 15, 1937	-	6.2
AA-Ae 8	Sept. 23, 1943	10	4.7	Do	Apr. 27, 1941	6	-
AA-Ae 9	Sept. 24, 1943	10	4.7	Do	Oct. 1, 1941	8	-
AA-Bf 1	Aug. 3, 1943	5	5.9	Do	May 1, 1942	10	-
AA-Bf 2	Aug. 3, 1943	4	5.2	Do	Nov. 1, 1942	8	-
AA-Bf 4	Aug. 3, 1943	6	5.2	Do	May 11, 1943	12	6.3
Bal-Fe 28	Aug. 11, 1914	91.6	-	Do	July 16, 1943	38	5.9
Bal-Gf 1	Feb. 1941	17	-	Do	July 26, 1943	17	5.9
Do	do	28	-	Do	Apr. 15, 1944	12	-
Do	Apr. 27, 1941	15	-	Do	Apr. 19, 1944	32	-
Do	Sept. 24, 1941	50	-	Bal-Gf 33	June 14, 1937	9.7	-
Do	Oct. 1, 1941	50	-	Do	Dec. 15, 1937	-	5.7
Bal-Gf 14	May 12, 1943	250	5.9	Do	Mar. 7, 1941	35	-
Do	May 14, 1943	241	3.0	Do	do	7	-
Bal-Gf 18	May 12, 1943	252	6.7	Do	Apr. 27, 1941	80	-
Do	May 14, 1943	276	-	Do	Oct. 1, 1941	40	-
Do	do	266	-	Do	May 1, 1942	22	-
Do	do	254	-	Do	Nov. 1, 1942	95	-
Bal-Gf 21	May 25, 1944	1,475	-	Do	May 11, 1943	172	5.9.
Bal-Gf 28	Sept. 28, 1936	30	-	Bal-Gf 34	Dec. 15, 1937	-	6.1
Do	Dec. 3, 1940	710	6.1	Do	May 1, 1940	65	-
Do	May 2, 1940	540	-	Do	Nov. 27, 1940	-	5.5
Do	Mar. 6, 1941	375	-	Do	Mar. 6, 1941	18	-
Do	do	1,070	-	Do	do	78	-
Do	Feb. 1941	525	-	Do	Apr. 27, 1941	70	-
Do	do	640	-	Do	Oct. 1, 1941	40	-
Do	Apr. 8, 1941	380	-	Do	May 1, 1942	52	-
Do	do	1,070	-	Do	Nov. 1, 1942	74	-
Do	Oct. 1, 1941	525	-	Do	May 11, 1943	128	5.9
Do	Feb. 3, 1944	320	-	Do	Feb. 3, 1944	50	-
Do	Feb. 4, 1944	362	-	Do	do	110	-
Do	Feb. 5, 1944	380	-	Bal-Gf 37	Dec. 15, 1937	-	6.2
Bal-Gf 29	May 2, 1938	-	5.5	Do	Nov. 27, 1940	-	5.3
Do	Oct. 13, 1938	120	5.6	Do	Apr. 27, 1941	12	-
Do	May 9, 1940	325	5.8	Do	Oct. 1, 1941	15	-
Do	Dec. 3, 1940	398	-	Do	May 1, 1942	20	-
Do	Mar. 3, 1941	340	-	Do	May 11, 1943	27	5.3
Do	do	400	-	Do	July 30, 1943	26	5.3
Do	Mar. 5, 1941	200	-	Do	Sept. 7, 1943	25	5.5
Do	do	403	-	Do	Feb. 3, 1944	22	-
Do	Oct. 1, 1941	372	-	Bal-Gf 38	Dec. 15, 1937	-	5.4
Do	Feb. 3, 1944	595	-	Do	Mar. 5, 1941	54	-
Do	Feb. 5, 1944	560	-	Do	do	174	-
Do	Feb. 26, 1944	550	-	Do	Mar. 24, 1941	50	-

TABLE 14—*Continued*

Patapsco formation—*Continued*

Well	Date	Cl	pH	Well	Date	Cl	pH
Bal-Gf 38	Mar. 24, 1941	220	-	Bal-Gf 108	Sept. 1, 1943	6	5.7
Do	Apr. 7, 1941	45	-	Do	Sept. 7, 1943	6	6.5
Do	do	110	-	Do	Oct. 7, 1943	6	5.7
Do	Oct. 1, 1941	220	-	Do	Nov. 4, 1943	4	6.5
Do	May 1, 1942	190	-	Do	July 13, 1944	9	6.3
Do	May 11, 1943	206	5.9	Bal-Gf 109	Oct. 27, 1920	602	-
Do	May 9, 1944	218	5.7	Do	Oct. 28, 1920	565	-
Bal-Gf 46	Mar. 9, 1936	8.7	6.6	Bal-Gf 110	Oct. 27, 1920	424	-
Do	Feb. 27, 1941	7.5	-	Do	Oct. 28, 1920	408	-
Do	Sept. 1, 1941	70	-	Bal-Gf 111	Oct. 27, 1920	152	-
Do	June 1, 1942	69	-	Do	Oct. 28, 1920	156	-
Do	Jan. 1943	58	-	Bal-Gf 112	Oct. 28, 1920	99.5	-
Bal-Gf 50	Mar. 9, 1936	152	6.4	Bal-Gf 113	Oct. 27, 1920	262	-
Do	Dec. 2, 1940	55	6.8	Do	Oct. 28, 1920	269	-
Do	Feb. 26, 1941	64	-	Do	Jan. 20, 1931	101	-
Do	Mar. 5, 1941	26	-	Do	Mar. 31, 1931	101	-
Do	do	68	-	Do	Apr. 5, 1931	290	-
Do	Sept. 1, 1941	15	-	Do	Apr. 11, 1931	603	-
Do	June 1, 1942	8	-	Do	Apr. 14, 1931	510	-
Do	Jan. 1943	10	-	Do	Apr. 26, 1931	645	-
Do	Mar. 1943	68	-	Do	May 4, 1931	616	-
Bal-Gf 79	Mar. 5, 1926	82	-	Do	May 13, 1931	566	-
Do	Apr. 26, 1941	29	-	Do	May 17, 1931	538	-
Do	Sept. 27, 1941	20	-	Do	May 27, 1931	516	-
Do	May 20, 1943	23	-	Do	June 2, 1931	525	-
Bal-Gf 80	Mar. 5, 1926	41.1	-	Do	June 10, 1931	487	-
Do	Apr. 26, 1941	22.5	-	Bal-Gf 114	Oct. 7, 1915	187	-
Do	Sept. 7, 1941	25	-	Do	Oct. 27, 1920	212	-
Do	June 1, 1942	30	-	Do	Oct. 28, 1920	211	-
Do	Oct. 8, 1942	30	-	Do	Jan. 20, 1931	1,063	-
Do	May 20, 1943	14	-	Do	Mar. 31, 1931	1,063	-
Bal-Gf 89	1924	7	-	Do	Apr. 5, 1931	503	-
Bal-Gf 91	1924	7	-	Do	Apr. 11, 1931	575	-
Do	Sept. 1941	15	-	Do	Apr. 14, 1931	460	-
Bal-Gf 98	Nov. 20, 1940	14	5.6	Do	Apr. 26, 1931	390	-
Do	Oct. 1, 1941	20	-	Do	May 5, 1931	390	-
Bal-Gf 100	May 20, 1943	21	-	Do	May 13, 1931	419	-
Bal-Gf 106	Nov. 28, 1935	10.5	-	Do	May 17, 1931	448	-
Do	Dec. 16, 1940	14	-	Do	May 27, 1931	319	-
Do	Oct. 1, 1941	200	-	Do	June 2, 1931	440	-
Do	do	15	-	Bal-Gf 115	Oct. 7, 1915	16	-
Do	Feb. 1942	10.5	-	Bal-Gf 116	Oct. 7, 1915	41	-
Do	June 1, 1942	195	-	Do	Oct. 27, 1920	905	-
Bal-Gf 107	Oct. 1, 1941	14	-	Do	Oct. 28, 1920	905	-
Do	June 1, 1942	8	-	Do	Jan. 1, 1931	215	-
Do	Nov. 1, 1942	15	-	Do	Mar. 31, 1931	215	-
Do	May 27, 1943	9	6.6	Do	Apr. 5, 1931	1,180	-
Do	July 26, 1943	8	5.7	Do	Apr. 14, 1931	1,130	-
Do	Aug. 18, 1943	7	5.5	Do	Apr. 26, 1931	1,030	-
Do	Sept. 1, 1943	7	5.7	Do	May 5, 1931	992	-
Do	Sept. 7, 1943	8	6.5	Do	May 13, 1931	956	-
Do	Oct. 7, 1943	6	5.5	Do	May 17, 1931	1,010	-
Bal-Gf 108	Nov. 29, 1940	-	6.5	Do	May 27, 1931	1,000	-
Do	June 1, 1942	8	-	Do	June 2, 1931	970	-
Do	Nov. 1, 1942	12	-	Do	June 22, 1931	1,000	-
Do	May 27, 1943	8	6.7	Do	July 2, 1931	1,020	-
Do	July 26, 1943	8	5.7	Do	July 8, 1931	976	-
Do	Aug. 4, 1943	6	5.9	Bal-Gf 117	Oct. 7, 1915	2.9	-
Do	Aug. 18, 1943	6	5.7	Do	Oct. 27, 1920	7.06	-

TABLE 14—*Continued*

Patapsco formation—*Continued*

Well	Date	Cl	pH
Bal-Gf 117	Oct. 28, 1920	10.6	-
Bal-Gf 118	Oct. 7, 1915	14.4	-
Do	Oct. 27, 1920	7.07	-
Do	Oct. 28, 1920	10.6	-
Do	Sept. 15, 1931	8.85	-
Do	Oct. 14, 1931	6.55	-
Do	Nov. 11, 1931	7.08	-
Do	June 6, 1931	5.2	-
Do	June 15, 1931	8.85	-
Do	June 22, 1931	8.12	-
Do	July 2, 1931	10.6	-
Do	July 14, 1931	8.85	-
Do	Aug. 21, 1935	28.5	-
Do	Sept. 25, 1935	21.1	-
Bal-Gf 119	Oct. 7, 1915	22.5	-
Bal-Gf 120	June 15, 1931	12.4	-
Do	July 2, 1931	39.0	-
Do	July 8, 1931	24.9	-
Do	July 14, 1931	33.6	-
Do	July 21, 1931	32.0	-
Do	July 31, 1931	42.5	-
Do	Aug. 31, 1931	24.6	-
Do	Sept. 7, 1931	28.3	-
Do	Sept. 23, 1931	31.2	-
Do	Nov. 11, 1931	117	-
Do	Aug. 21, 1935	42.6	-
Do	Sept. 25, 1935	14.2	-
Do	Oct. 26, 1935	21.2	-
Do	Nov. 26, 1935	28.4	-
Bal-Gf 121	Jan. 20, 1931	7.09	-
Do	Feb. 25, 1931	6.77	-
Do	Apr. 5, 1931	21.3	-
Do	June 15, 1931	10.6	-
Do	June 22, 1931	13.0	-
Do	July 8, 1931	12.4	
Do	July 14, 1931	12.4	-
Do	July 21, 1931	29.0	-
Do	July 31, 1931	10.6	-
Bal-Gf 122	Jan. 20, 1931	136	-
Do	Apr. 15, 1931	462	-
Do	Apr. 28, 1931	1,030	-
Do	May 4, 1931	1,070	-
Do	May 13, 1931	1,132	-
Do	May 17, 1931	1,175	-
Do	May 27, 1931	1,205	-
Do	June 2, 1931	1,232	-
Bal-Gf 123	Oct. 27, 1920	10.6	-
Do	Oct. 28, 1920	14.2	-
Do	Jan. 20, 1931	53.1	-
Do	Apr. 8, 1931	28.3	-
Do	June 15, 1931	99.5	-
Do	June 22, 1931	139	-
Do	July 8, 1931	312	-
Do	July 14, 1931	192	-
Do	July 21, 1931	113	-
Bal-Gf 125	Oct. 27, 1920	106.5	-
Do	Oct. 28, 1920	85	-
Do	Jan. 20, 1931	355	-
Do	Apr. 8, 1931	568	-
Bal-Gf 125	Apr. 14, 1931	565	-
Do	Apr. 28, 1931	245	-
Do	May 13, 1931	270	-
Do	May 17, 1931	341	-
Do	June 2, 1931	312	-
Do	June 22, 1931	270	-
Do	July 2, 1931	227	-
Do	July 8, 1931	85.2	-
Do	July 31, 1931	81.5	-
Bal-Gf 126	Oct. 27, 1920	14.2	-
Do	Oct. 28, 1920	10.6	-
Do	Sept. 7, 1931	24.9	-
Do	Sept. 15, 1931	17.5	-
Bal-Gf 127	Oct. 28, 1920	10.6	-
Do	Jan. 20, 1931	181	-
Do	Apr. 8, 1931	160	-
Do	Apr. 11, 1931	142	-
Do	Apr. 28, 1931	135	-
Do	May 13, 1931	110	-
Do	May 17, 1931	128	-
Do	June 2, 1931	113	-
Do	June 22, 1931	99.5	-
Do	July 2, 1931	85.3	-
Do	July 8, 1931	95.8	-
Do	July 21, 1931	81.6	-
Do	Sept. 7, 1931	7.1	-
Do	Sept. 15, 1931	17.7	-
Do	Dec. 14, 1932	7.1	-
Bal-Gf 128	Jan. 21, 1931	536	-
Do	Apr. 8, 1931	509	-
Do	Apr. 11, 1931	500	-
Do	Apr. 14, 1931	320	-
Do	Apr. 28, 1931	482	-
Do	May 13, 1931	398	-
Do	May 17, 1931	512	-
Do	May 27, 1931	476	-
Do	June 2, 1931	440	-
Do	June 22, 1931	214	-
Do	July 2, 1931	128	-
Do	July 8, 1931	65.8	-
Do	July 14, 1931	67.5	-
Do	July 21, 1931	42.5	-
Do	July 31, 1931	35.6	-
Do	Dec. 14, 1932	7.1	-
Bal-Gf 129	Apr. 8, 1931	7.5	-
Do	June 6, 1931	12.9	-
Do	July 8, 1931	31.4	-
Do	July 21, 1931	20.6	-
Do	Aug. 31, 1931	10.6	-
Do	Sept. 23, 1931	14.2	-
Do	Oct. 14, 1931	21.4	-
Do	Feb. 16, 1938	10.6	-
Do	Mar. 6, 1938	14.2	-
Do	May 19, 1938	3.5	-
Do	Aug. 6, 1938	14.2	-
Do	Sept. 15, 1938	35.4	-
Do	Sept. 30, 1938	172	-
Do	Oct. 10, 1938	79	-
Do	Oct. 13, 1938	156	-

TABLE 14—*Continued*

Patapsco formation—*Continued*

Well	Date	Cl	pH	Well	Date	Cl	pH
Bal-Gf 129	Oct. 20, 1938	159	-	Bal-Gf 130	May 9, 1938	131	-
Do	Nov. 3, 1938	81.6	-	Do	July 28, 1938	205	-
Do	Dec. 1, 1938	60.0	-	Do	Sept. 30, 1938	191	-
Do	Dec. 15, 1938	46.2	-	Do	Oct. 10, 1938	199	-
Do	Jan. 5, 1939	128	-	Do	Oct. 13, 1938	178	-
Do	Jan. 19, 1939	277	-	Do	Nov. 3, 1938	135	-
Do	Feb. 2, 1939	440	-	Do	Nov. 18, 1938	103	-
Do	Feb. 27, 1939	508	-	Do	Dec. 29, 1938	397	-
Do	Mar. 9, 1939	540	-	Do	Jan. 12, 1939	490	-
Do	Apr. 3, 1939	610	-	Do	Jan. 26, 1939	552	-
Do	Apr. 17, 1939	730	-	Do	Feb. 6, 1939	575	-
Do	Apr. 20, 1939	632	-	Do	Feb. 20, 1939	615	-
Do	May 1, 1939	666	-	Do	Mar. 2, 1939	610	-
Do	May 11, 1939	638	-	Do	Mar. 16, 1939	623	-
Do	May 25, 1939	655	-	Do	Apr. 3, 1939	623	-
Do	June 4, 1939	696	-	Do	Apr. 20, 1939	616	-
Do	June 15, 1939	730	-	Do	May 1, 1939	680	-
Do	June 27, 1939	760	-	Do	May 18, 1939	668	-
Do	July 10, 1939	705	-	Do	June 2, 1939	689	-
Do	July 24, 1939	805	-	Do	June 19, 1939	646	-
Do	Aug. 4, 1939	850	-	Do	July 6, 1939	639	-
Do	Aug. 17, 1939	880	-	Do	July 28, 1939	610	-
Do	Sept. 4, 1939	950	-	Do	Aug. 10, 1939	305	-
Do	Sept. 25, 1939	880	-	Do	Aug. 17, 1939	603	-
Do	Oct. 5, 1939	900	-	Do	Aug. 31, 1939	532	-
Do	Nov. 30, 1939	1,160	-	Do	Sept. 11, 1939	468	-
Do	Dec. 4, 1939	1,130	-	Do	Sept. 25, 1939	532	-
Do	Dec. 11, 1939	1,170	-	Do	Oct. 2, 1939	540	-
Do	Dec. 14, 1939	1,100	-	Do	Nov. 30, 1939	525	-
Do	Dec. 21, 1939	1,010	-	Do	Dec. 7, 1939	639	-
Do	Jan. 1, 1940	1,030	-	Do	Dec. 28, 1939	799	-
Do	Jan. 8, 1940	1,040	-	Do	Jan. 15, 1940	746	-
Do	Jan. 11, 1940	995	-	Do	Mar. 7, 1940	667	-
Do	Mar. 7, 1940	269	-	Do	Mar. 25, 1940	532	-
Do	Mar. 28, 1940	328	-	Do	Apr. 4, 1940	745	-
Do	Apr. 22, 1940	497	-	Do	Apr. 22, 1940	754	-
Do	May 2, 1940	149	-	Do	Apr. 25, 1940	580	-
Do	May 9, 1940	92.2	-	Do	May 9, 1940	468	-
Do	May 20, 1940	63.8	-	Do	May 20, 1940	404	-
Do	May 30, 1940	35.5	-	Do	May 30, 1940	340	-
Do	June 7, 1940	63.8	-	Do	June 10, 1940	273	-
Do	June 14, 1940	31.9	-	Do	July 1, 1940	241	-
Do	July 1, 1940	24.9	-	Do	July 15, 1940	220	-
Do	Aug. 1, 1940	17.7	-	Do	July 29, 1940	206	-
Do	Sept. 3, 1940	14.1	-	Do	Aug. 8, 1940	181	-
Do	Sept. 23, 1940	10.6	-	Do	Aug. 26, 1940	156	-
Do	Oct. 7, 1940	56.6	-	Do	Sept. 13, 1940	142	-
Do	Oct. 21, 1940	10.6	-	Do	Sept. 30, 1940	128	-
Do	Nov. 4, 1940	10.6	-	Do	Oct. 17, 1940	127	-
Do	Nov. 18, 1940	8.85	-	Do	Nov. 8, 1940	74.5	-
Do	Dec. 21, 1940	10.6	-	Do	Nov. 18, 1940	81.5	-
Do	Sept. 1941	110	-	Do	Nov. 28, 1940	95.9	-
Bal-Gf 130	Oct. 27, 1920	8.5	-	Do	Dec. 2, 1940	92.3	-
Do	Oct. 28, 1920	7.8	-	Bal-Gf 137	July 21, 1931	270	-
Do	June 15, 1931	21.2	-	Do	Aug. 31, 1931	213	-
Do	June 27, 1931	30.2	-	Do	Sept. 15, 1931	160	-
Do	July 8, 1931	170	-	Do	Oct. 14, 1931	135	-
Do	July 31, 1931	30.5	-	Do	Nov. 11, 1931	103	-
Do	Sept. 15, 1931	46.1	-	Do	Nov. 30, 1931	85.2	-
Do	Feb. 16, 1938	101	-	Do	Dec. 17, 1931	71.0	-
Do	Mar. 6, 1938	227	-	Do	Dec. 14, 1932	88.7	-
Do	Mar. 24, 1938	63.8	-	Do	Aug. 21, 1935	242	-

TABLE 14—*Continued*
Patapsco formation—*Continued*

Well	Date	Cl	pH	Well	Date	Cl	pH
Bal-Gf 137	Sept. 25, 1935	195	-	Bal-Gf 138	July 6, 1939	74.5	-
Do	Dec. 23, 1935	187	-	Do	Aug. 4, 1939	63.8	-
Do	Jan. 30, 1936	214	-	Do	Aug. 17, 1939	28.4	-
Do	June 29, 1936	214	-	Do	Sept. 7, 1939	71.0	-
Do	Aug. 26, 1936	220	-	Do	Oct. 12, 1939	78	-
Do	Oct. 17, 1936	245	-	Do	Nov. 6, 1939	92.3	-
Do	Dec. 22, 1936	362	-	Do	Nov. 13, 1939	113	-
Do	Mar. 25, 1937	358	-	Do	Nov. 30, 1939	152	-
Do	May 31, 1937	383	-	Do	Dec. 21, 1939	142	-
Do	July 2, 1937	379	-	Do	Jan. 11, 1940	131	-
Do	Oct. 26, 1937	380	-	Do	Feb. 5, 1940	113	-
Do	Jan. 19, 1938	376	-	Do	Mar. 11, 1940	113	-
Do	Mar. 6, 1938	383	-	Do	Apr. 8, 1940	92.3	-
Do	Mar. 24, 1938	308	-	Do	May 16, 1940	81.6	-
Do	Apr. 22, 1938	337	-	Do	June 27, 1940	85	-
Do	June 1, 1938	244	-	Do	Aug. 1, 1940	71	-
Do	June 23, 1938	383	-	Do	Aug. 15, 1940	81.6	-
Do	July 21, 1938	434	-	Do	Oct. 3, 1940	78	-
Do	Oct. 13, 1938	852	-	Do	Nov. 11, 1940	81.6	-
Do	Oct. 27, 1938	695	-	Do	Dec. 2, 1940	78	-
Do	Nov. 10, 1938	578	-	Do	Sept. 1941	84	-
Do	June 15, 1943	475	-	Bal-Gf 140	Feb. 3, 1940	1,275	-
Do	June 22, 1943	420	-	Do	Feb. 9, 1940	1,206	-
Do	July 11, 1943	1,100	-	Do	Feb. 15, 1940	1,152	-
Do	July 26, 1943	1,150	5.7	Do	Feb. 20, 1940	1,063	-
Do	Aug. 4, 1943	642	5.9	Do	Apr. 25, 1940	1,311	-
Do	Aug. 18, 1943	456	5.4	Do	Apr. 29, 1940	1,080	-
Do	Aug. 24, 1943	436	5.9	Do	May 2, 1940	880	-
Do	Aug. 27, 1943	430	-	Do	May 9, 1940	652	-
Do	Sept. 1, 1943	424	5.8	Do	May 20, 1940	560	-
Do	Sept. 28, 1943	408	-	Do	May 30, 1940	510	-
Do	Oct. 7, 1943	411	5.5	Do	June 14, 1940	482	-
Do	Dec. 9, 1943	416	5.8	Do	July 4, 1940	475	-
Do	Feb. 5, 1944	398	-	Do	July 18, 1940	467	-
Do	Mar. 11, 1944	400	-	Do	Aug. 1, 1940	467	-
Do	Apr. 21, 1944	403	5.9	Do	Sept. 5, 1940	463	-
Do	May 9, 1944	404	5.7	Do	Sept. 26, 1940	472	-
Do	June 13, 1944	405	5.7	Do	Oct. 10, 1940	418	-
Do	July 13, 1944	405	5.9	Do	Oct. 14, 1940	504	-
Bal-Gf 138	Oct. 17, 1936	284	-	Do	Nov. 4, 1940	383	-
Do	Nov. 25, 1936	35.4	-	Do	Nov. 18, 1940	475	-
Do	Mar. 6, 1937	37.5	-	Do	Dec. 2, 1940	461	-
Do	May 5, 1937	30.2	-	Do	Sept. 1941	315	-
Do	Aug. 10, 1937	32	-	Do	July 10, 1943	132	-
Do	Oct. 26, 1937	39	-	Do	July 12, 1943	56	-
Do	Jan. 27, 1938	42.6	-	Do	July 17, 1943	220	-
Do	Mar. 6, 1938	149	-	Do	July 21, 1943	75	-
Do	Mar. 18, 1938	336	-	Do	July 26, 1943	62	5.7
Do	Mar. 20, 1938	103	-	Do	July 31, 1943	60	-
Do	Mar. 21, 1938	74.5	-	Bal-Gf 166	Dec. 14, 1937	-	5.9
Do	Apr. 30, 1938	49.7	-	Do	Mar. 7, 1941	118	-
Do	June 16, 1938	42.5	-	Do	do	94	-
Do	Sept. 30, 1938	35.5	-	Do	Apr. 26, 1941	116	-
Do	Oct. 20, 1938	56.7	-	Do	Oct. 1, 1941	20.0	-
Do	Dec. 10, 1938	42.5	-	Do	Apr. 1942	22.5	-
Do	Jan. 5, 1939	39.0	-	Do	Nov. 1, 1942	173	-
Do	Jan. 30, 1939	35.5	-	Do	May 17, 1943	200	3.8
Do	Mar. 6, 1939	39.0	-	Do	Dec. 2, 1943	933	-
Do	Mar. 27, 1939	56.7	-	Do	do	254	-
Do	Apr. 17, 1939	63.8	-	Bal-Gf 167	Mar. 4, 1941	10	-
Do	May 11, 1939	78.0	-	Do	Oct. 1, 1941	14	-
Do	June 2, 1939	81.5	-	Do	Nov. 1, 1942	35	-

TABLE 14—*Continued*
Patapsco formation—*Continued*

Well	Date	Cl	pH	Well	Date	Cl	pH
Bal-Gf 167	May 17, 1943	172	6.2	Bal-Gf 174	Dec. 14, 1937	-	5.9
Do	Aug. 4, 1943	25	5.3	Do	Apr. 27, 1941	6.5	-
Do	Dec. 2, 1943	90	-	Do	Oct. 1, 1941	18	-
Do	do	20	-	Do	Apr. 30, 1942	16	-
Bal-Gf 168	Dec. 14, 1937	-	6.2	Do	Nov. 1, 1942	11	-
Do	Apr. 26, 1941	6.5	-	Do	May 17, 1943	74	5.2
Do	Oct. 1, 1941	160	-	Do	Dec. 1, 1943	36	-
Do	May 1942	19.5	-	Do	do	5	-
Do	Nov. 11, 1942	22	-	Bal-Gf 175	Dec. 14, 1937	-	5.7
Do	May 17, 1943	20	6.3	Do	Nov. 27, 1940	29	5.9
Do	Aug. 4, 1943	8	5.5	Do	Apr. 26, 1941	25.5	-
Do	Dec. 2, 1943	9	-	Do	Oct. 1, 1941	54	-
Do	Dec. 2, 1943	17	-	Do	Apr. 30, 1942	40	-
Bal-Gf 169	Dec. 14, 1937	6.0	-	Do	Oct. 1, 1942	49	-
Do	Mar. 6, 1941	108	-	Do	May 17, 1943	102	5.9
Do	Mar. 7, 1941	36	-	Do	Nov. 24, 1943	50	-
Do	Apr. 26, 1941	103	-	Do	Nov. 30, 1943	40	-
Do	Oct. 1, 1941	140	-	Do	Dec. 2, 1943	22	-
Do	May 1942	140	-	Do	Dec. 5, 1943	50	-
Do	Nov. 1, 1942	158	-	Do	Dec. 7, 1943	98	-
Do	May 17, 1943	160	5.3	Do	Dec. 11, 1943	80	-
Do	Dec. 2, 1943	214	-	Do	Dec. 20, 1943	84	-
Do	do	128	-	Do	Dec. 31, 1943	76	-
Bal-Gf 170	Dec. 14, 1937	-	6.3	Do	Jan. 15, 1944	74	-
Do	Mar. 4, 1937	30	-	Do	Feb. 15, 1944	79	-
Do	Apr. 26, 1941	31	-	Do	Mar. 10, 1944	22	-
Do	Sept. 27, 1941	66	-	Do	Mar. 15, 1944	132	-
Do	Oct. 1, 1941	86	-	Do	Mar. 23, 1944	82	-
Do	Apr. 30, 1942	7.0	-	Do	Apr. 24, 1944	78	-
Do	Nov. 1, 1942	80	-	Do	May 24, 1944	90	-
Do	May 17, 1943	188	6.8	Do	July 24, 1944	72	-
Do	Aug. 4, 1943	-	5.1	Do	Sept. 28, 1944	74	-
Do	Dec. 2, 1943	202	-	Do	Oct. 19, 1944	73	-
Do	do	80	-	Do	Nov. 16, 1944	70	-
Bal-Gf 171	Dec. 14, 1937	-	6.2	Do	Nov. 24, 1943	40	-
Do	Apr. 27, 1941	5	-	Do	do	50	-
Do	Sept. 27, 1941	10	-	Bal-Gf 176	Oct. 1, 1941	38	-
Do	Oct. 1, 1941	66	-	Do	Apr. 30, 1942	36	-
Do	Apr. 20, 1942	63	-	Do	Nov. 1, 1942	82	-
Do	Nov. 1, 1942	18	-	Do	May 17, 1943	70	5.3
Do	May 17, 1943	33	6.7	Do	July 26, 1943	85	5.3
Do	Aug. 4, 1943	6	5.7	Do	Aug. 11, 1943	83	5.4
Do	Dec. 2, 1943	10	-	Do	Aug. 18, 1943	81	5.7
Do	do	5	-	Do	Aug. 24, 1943	81	5.7
Bal-Gf 172	Sept. 14, 1937	-	6.1	Do	Sept. 1, 1943	83	5.5
Do	Apr. 27, 1941	5.5	-	Do	Sept. 8, 1943	85	5.3
Do	Sept. 27, 1941	16	-	Do	Oct. 7, 1943	84	4.9
Do	Oct. 1, 1941	81	-	Do	Nov. 3, 1943	86	5.7
Do	May 1942	75	-	Bal-Gf 178	Aug. 4, 1943	4	6.7
Do	Nov. 1, 1942	7.5	-	Bal-Gf 179	June 3, 1943	3	5.9
Do	May 17, 1943	9	6.7	Bal-Gf 180	June 3, 1943	3	5.5
Do	Dec. 2, 1943	4	-	Bal-Gf 182	June 12, 1944	5	-
Bal-Gf 173	Dec. 14, 1937	-	5.9	Bal-Gf 192	Feb. 17, 1944	60	-
Do	Mar. 4, 1941	67	-	Do	do	370	-
Do	Mar. 7, 1941	32	-	Do	Feb. 22, 1944	360	-
Do	Apr. 27, 1941	55	-	Do	Mar. 1, 1944	400	-
Do	Oct. 1, 1941	80	-	Do	Mar. 5, 1944	395	-
Do	Nov. 1, 1942	155	-	Do	Mar. 12, 1944	360	-
Do	May 17, 1943	180	5.3	Do	Mar. 16, 1944	355	-
Do	Aug. 4, 1943	180	-	Do	Mar. 25, 1944	325	-
Do	Dec. 2, 1943	206	-	Do	Mar. 30, 1944	310	-
Do	do	140	-	Do	Apr. 6, 1944	335	-

TABLE 14—*Continued*

Patapsco formation—*Continued*

Well	Date	Cl	pH	Well	Date	Cl	pH
Bal-Gf 192	Apr. 15, 1944	375	-	Har-Ed 16	Apr. 13, 1944	9	5.3
Do	Apr. 26, 1944	340	3.5	Har-Ed 19	Apr. 13, 1944	8	5.3
Do	June 7, 1944	325	-	Har-Ed 20	Apr. 13, 1944	9	5.3
Do	July 24, 1944	340	-				

Pleistocene deposits

Well	Date	Cl	pH	Well	Date	Cl	pH
1S1E-8	June 13, 1944	80	6.1	Bal-Gc 1	Oct. 6, 1943	9	6.0
1S1E-9	June 13, 1944	66	6.7	Har-De 2	Oct. 10, 1943	10	5.3
1S1E-10	June 13, 1944	106	6.3	Har-De 6	July 7, 1944	17	5.5
1S1E-11	June 13, 1944	126	6.4	Har-De 18	Sept. 12, 1944	10	5.4
2S1E-41	May 29, 1944	5,205	7.3	Har-Ed 7	1944	75-80	-
2S1E-73	May 29, 1944	958	5.7	Har-Ed 14	Apr. 13, 1944	18	5.4
1N5E-1	June 18, 1943	40	6.9				

[a]*Well also screened in Patapsco formation.*

Cations		*Anions*	
Calcium (Ca)	0.04990	Carbonate (CO_3)	0.03333
Magnesium (Mg)	.08224	Bicarbonate (HCO_3)	.01639
Sodium (Na)	.04348	Sulfate (SO_4)	.02082
Potassium (K)	.02558	Chloride (Cl)	.02820
		Nitrate (NO_3)	.01613

To classify and compare a large number of chemical analyses, the reacting values of the radicals generally are plotted on a trilinear graph on which the chemical character of the water may be represented by a single point. Geyer (1945, pp. 283-287) in his study in the Baltimore area used a rectilinear graph that he devised, and for many chemical analyses in this area it appears to have some advantage over the trilinear graphs.

Many combinations of trilinear and rectilinear graphic plotting (Hill, 1940; Langelier and Ludwig, 1942; Piper, 1945) were used in an attempt to find some manner of expression that would show clearly the differences in chemical character but, more specifically, the presence of a slight degree of salt-water contamination. A bar diagram of the reacting values (fig. 23) appeared to show best the salt-water contamination in this area. For example, in Figure 23, the distribution of reacting values of analyses 1, 2, 10, 11, 12, 22, 25, and 26, owing chiefly to the low percentage of the reacting value of chloride, indicates no contamination, although the chloride, in parts per million, ranges from 1.4 to 8.6. When the water contains minerals introduced by salt-water contamination the normal pattern shown by the percentages of reacting values is changed, chiefly by a relative increase in the percentage of the reacting values of sodium and chloride (to which, for convenience in plotting, the reacting values of potassium and nitrate have been added respectively). For example, the diagram of analysis 15 shows a considerable increase in the percentage of reacting values of these constituents, indicating that the chemical character of the water has been changed by salt-water contamination. In this case salt-water contamination is shown clearly also by the high concentration of chloride—990 parts per million. However, other analyses (for example 16, 23, and 28) show that the relative percentage of chloride is higher than normal, indicating salt-water contamination, even though the chloride content shown by these analyses is only 5.9, 7.4, and 5.5 parts per million, respectively, all of which are within the range of chloride concentration of uncontaminated ground water. The significant value of this method of presentation is that it permits an early detection of salt-water contamination.

GEOPHYSICAL METHODS

Geophysical methods are of considerable value in determining indirectly localities of salt-water contamination and the approximate salinity within the contaminated area. Resistivity studies in which the resistivity of the water-bearing formations is determined by use of electrodes placed at the land surface have been used for many years to provide data on salt-water contamination of ground-water reservoirs. However, as the Baltimore area is heavily industrialized, with many pipe lines at shallow depth and stray electrical currents from grounded motors, etc., it was considered impractical to use this method of study in the Baltimore area.

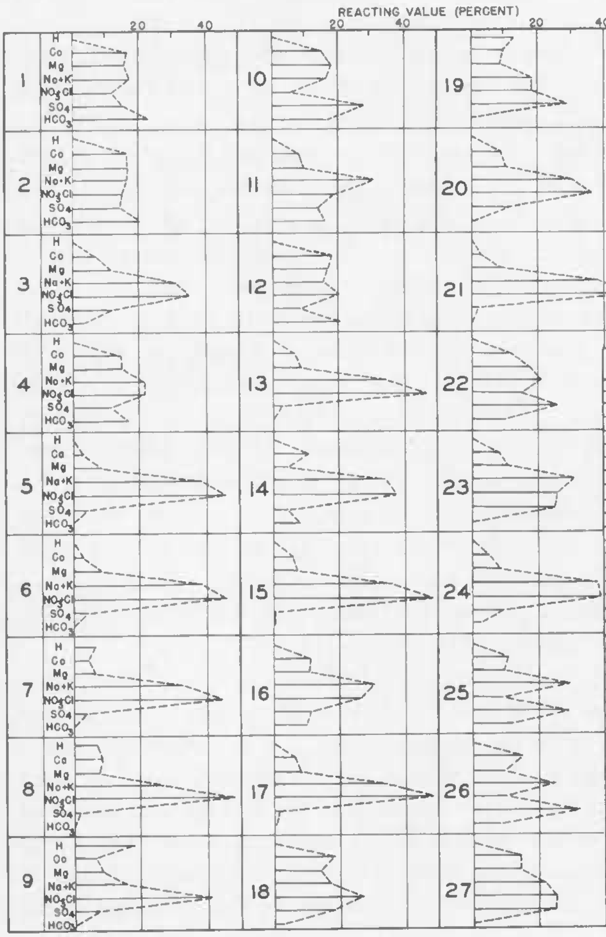
The electrical logging of test holes, which may avoid much of the disturbing effect from extraneous electrical currents and pipe lines, is a valuable method of studying salt-water contamination, but its use is limited by the availability of test holes.

Electrical logs generally consist of one potential curve and several resistivity curves obtained through the use of one or more electrodes moved upward or downward in an uncased well. As commercial logging services were not readily available in the Baltimore area, a simplified logging unit, yielding one resistance curve, was constructed to determine if electrical logging would provide helpful information on salt-water contamination, as well as on the thickness and position of water-bearing formations. The logs are not as accurate or detailed as those obtained with more elaborate equipment.

The resistance curve was obtained by causing an electrical current to flow from a single electrode in the well to an electrode at the land surface. A constant voltage was applied; hence the amount of current flowing through the circuit was controlled by the electrical resistance of the sediments, and the water they contained, between the two electrodes. As the density of current flow lines is large around a small electrode in a well, the resistance of the sediments very close to that electrode had the greatest influence on the quantity of current flowing in the circuit. The current was automatically recorded on a recording milliammeter as the electrode was moved up or down the well. With the current and voltage known, the resistance was computed by Ohm's law.

Ordinarily, the electrical resistance of fresh-water-bearing sand and gravel is greater than that of saturated clay. A salt-water sand, however, may have a very low resistance because salt water is more conductive than fresh water. Thus, under ideal conditions, if supplemental information is available to distinguish between the effects of the rocks and those of water salinity, the resistance curve may provide qualitative information on the salinity of water-bearing formations. In rotary-drilled wells in which a drilling mud is circulated in the bore hole, salt water in a sand may be freshened by invasion of the water from the drilling mud. If the invasion of drilling mud is sufficiently extensive, it may not be possible to detect the location and degree of salinity of the water in the sand by use of a resistance curve obtained by this single-electrode method. The resistance curve also shows the position and thickness of the different types of sediments and is of value in geologic correlation.

The potential curve was obtained by measuring, at depth intervals of 1 foot, the natural electrical potential between an electrode in the well and an electrode at the land surface, using a sensitive electronic millivoltmeter. An electrical potential in a well may result from several causes (Guyod, 1944, pp. 44-56). The electrical potential seems to develop most commonly between a clay bed, in contact with the fluid in a well, and a salt-water sand. If the salinity of the salt-water sand is higher than that of the fluid in the well, an electrical current will flow (assuming current flows from plus to minus potential) from the clay to the fluid in the well, then to the salt-water sand, then to the clay, completing the circuit. If the salinity of the fluid in the well



NO.	WELL	DEPTH (feet)	FORMATION	Cl (p.p.m.)
	SPARROWS POINT DISTRICT			
1	Bal-Gf 139	615	PATUXENT	5.5
2	Bal-Gf 32	668	do.	10.3
3	Bal-Gf 93	502	do	47
4	Bal-Gf 8	618	do	13
5	Bal-Gf 137	281	PATAPSCO	398
6	Bal-Gf 175	300	do.	70
7	Bal-Gf 192	280	do	335
8	Bal-Gf 28	177	do	320
9	Bal-Gf 176	322	do.	57
10	Bal-Gf 179	400	do.	1.6
	BACK RIVER DISTRICTS			
11	Bal-Fe 3		PATUXENT	4.5
	DUNDALK-CANTON DISTRICT			
12	3S5E-2	379	PATUXENT	2.2
13	2S3E-7	330	do.	765
14	2S3E-6	430	do.	340
15	3S3E-2	165	do	990
16	3S5E-11	301	do.	59
17	3S5E-9	130	PATAPSCO	107
	HIGHLANDTOWN DISTRICT			
18	1S4E-2	215	PATUXENT	20
19	2S4E-2	180	do	170
20	1S3E-2	195	do	66
	HARBOR DISTRICT			
21	3S1E-1	150	PATUXENT	3,400
	CURTIS BAY DISTRICT			
22	6S2E-1	245	PATUXENT	1.5
23	6S2E-7	327	do.	7.4
24	6S2E-9	293	do.	360
25	AA-Ad 20	392	do	14
26	AA-Ad 7	312	do	14
27	6S2E-10	144	PATAPSCO	51
28	AA-Ad 5	127	do.	55
	PATAPSCO RIVER WATER-Ft. McHENRY			
29				4,320
	BAY WATER-BAY SHORE PARK			
30				2,410

FIGURE 23. Diagram showing, in percent, the reacting value of chemical constituents in ground water in the Baltimore industrial area

is higher than the salinity of the water sand then, theoretically, the current will be reversed. Thus a large negative potential generally indicates that the electrode is opposite a salt-water sand; a small negative potential measured opposite a bed known to be sand usually indicates that the sand contains fresh water. Because several other factors affect the potential, data on the chemical character of the water, the lithology of the sediments, and the conditions in the bore hole are necessary to interpret a potential graph.

Electrical logging of test holes was first applied in the Baltimore area in the study of the salt-water contamination in the Sparrows Point public-supply well field (wells Bal-Gf 166 to 176) in the southeastern part of the Sparrows Point district.

The public-supply well field, which furnishes water for both the town of Sparrows Point and the Bethlehem Steel Co. plant, contains eleven wells of which four are 200 to 220 feet deep and seven are 270 to 320 feet deep The wells 200 to 220 feet deep are screened in the upper part of the Patapsco formation and those 270 to 330 feet deep in the lower part of the Patapsco. In 1945 the shallower wells yielded water containing from about 150 to 200 parts per million of chloride; the deeper wells, with one exception, yielded water containing about 8 parts per million. The exception, well Bal-Gf 175, supplied nearly all the water used for public supply during 1945. The chloride content of the water from that well increased progressively and in 1945 was about 80 to 90 parts per million. Inasmuch as the other wells tapping the lower part of the Patapsco formation in the public-supply well field yield water having a chloride content of about 8 parts per million, it was first thought that well Bal-Gf 175 was being contaminated locally by leakage from a nearby well; however salinity pumping tests and conductivity surveys showed the well was being contaminated in some other manner.

It was thought that electrical logging might furnish additional data that would help toward the understanding of the problem at Sparrows Point and at the same time serve as a test of the usefulness of this type of geophysical study in other parts of the Baltimore area. Two test wells (wells Bal-Gf 193 and 194), financed by the Bethlehem Steel Co., were drilled and electrical logs and other data were obtained (Pls. 10 and 11).

The potential curve of the first test well (Bal-Gf 193) is omitted below a depth of 180 feet, owing to erratic values resulting from stray ground currents. The potential in the upper part of the Patapsco formation has a negative value of from 20 to 25 millivolts beyond the clay base line (the point generally assumed to be zero). Inasmuch as the drilling mud contained from 6 to 11 parts per million of chloride, it would seem that the salinity of the water in the upper part of the Patapsco is higher than the mud salinity. The relatively high degree of salinity is indicated also by the resistances of the sands in the upper part of the Patapsco for, in general, they range from 550 to 575 ohms whereas the resistance of the sands in the lower part of the Patapsco, which generally contains water of low chloride content, is about 600 to 625 ohms.

Samples of the drilling mud entering the well and leaving the well were collected simultaneously. The chloride content of these samples was determined, and the difference in content was plotted against the depth of the well at the time the samples were collected. (See mud-salinity log, Pl. 10.) The principal purpose of the mud-salinity log was to locate the position of the salt-water sands. It was thought that if a low-chloride mud fluid came in contact with a salt-water sand the mud fluid would be slightly contaminated and therefore would have a higher chloride content; hence the chloride content of the drilling mud leaving the well would be higher than that of the mud entering the well. The mud-salinity log shows no large difference in chloride content, suggesting that no water extremely high in chloride was penetrated by the well.

The principal features indicated by the geophysical tests on well Bal-Gf 193 are (1) the upper part of the Patapsco formation contains slightly contaminated water, (2) the lower part of the formation contains essentially uncontaminated water, and (3) the two water-bearing zones are separated, in this well, by only 13 feet of clay.

Two potential logs were made of the second test well (Bal-Gf 194), one with a wall-contact electrode and the other with a 3-inch-diameter electrode. Although both potential logs are included in Plate 11, the values of potential obtained with the 3-inch electrode probably are not reliable, as the electrode seemed to be affected by polarization.

The potentials recorded opposite all beds of sand in this well are negative with respect to the potentials opposite the clay beds. From this it would seem that the salinity of all the sands is higher than the salinity of the drilling mud, which contained from 12 to 18 parts per million of chloride; however, the make-up water for the drilling mud which was obtained from a well ending in the Patuxent formation may have a slightly different chemical character than water from the Patapsco formation. Chemical constituents other than chloride therefore, may have caused, in part, the relatively large negative potentials opposite the sand beds.

The resistance log shows that in general the sand in the upper part of the Patapsco formation has a resistance of about 450 to 500 ohms, whereas the main sand in the lower part of the Patapsco formation has a resistance of about 600 ohms. Thus, the lower resistance of the sand in the upper part of the Patapsco formation suggests that the sand contains more clay or more saline water than the sand in the lower part of the formation. If the resistance of the sand in the upper part of the formation was affected only by more highly saline water, the negative potentials in the upper part of the formation would be somewhat greater than the negative potentials in the lower part. On the other hand, the negative potentials usually are much less opposite a clayey sand than opposite a clean sand. As the negative potentials of the sands in the lower and upper parts of the formation were roughly the same, it appears that the upper part is both more argillaceous and contains a more highly saline water than the lower part.

The mud-salinity log of well Bal-Gf 194 suggests that the lower part of the basal sand and gravel of Pleistocene age may contain water with a relatively high chloride content. Otherwise the mud-salinity log shows no evidence of highly saline water-bearing sands.

The principal features indicated by geophysical tests on well Bal-Gf 194 are that the upper part of the Patapsco formation contains slightly contaminated water and that the lower part probably is not contaminated. In this well the clay bed separating the two water-bearing zones is 66 feet thick.

The marked thinning of the clay bed toward the southeast suggests that it pinches out, thereby allowing salt water to move from the upper zone to the lower zone and to reach the public-supply well Bal-Gf 175.

Although electrical logging and other geophysical tests have limitations, in any future detailed studies of the salt-water contaminated areas, consideration should be given to their use along with test drilling.

FACTORS AFFECTING THE SPREAD OR INCREASE IN SALINITY OF CONTAMINATED AREAS DUE TO SALT-WATER ENCROACHMENT

The present areal extent of salt-water contamination due to encroachment has developed over a period of 50 years or more, but during this period the rate of growth was not uniform. A large part of that area was contaminated during the period of 1920 to 1940 when most of the large ground-water supplies were developed. Although a large number of water samples for chloride determination were collected periodically from many wells, it is difficult to determine, with short periods of record, if the contaminated areas are expanding or if the degree of salinity within the contaminated areas is increasing.

It might seem that a knowledge of the hydrology and geology of the area should provide a basis for determining the probability of further increase in contamination, but so many factors are involved—some of them imperfectly understood—that it is practically impossible to resolve all of them.

PATUXENT FORMATION

Salt water has encroached into the Patuxent formation where it is exposed to the Patapsco River estuary in and near the Harbor district, and as the water table there is still below the level of the estuary, salt water continues to move into the formation. The contaminated area in the Patuxent formation could be expected, therefore, to expand until it reached practically all the major well fields in the industrial area; however, the heavy pumping from the Patuxent formation in the Harbor district withdraws a large part of the salt water, thereby preventing much of it from moving southeastward to other well fields. This constitutes a sort of "protective pumping," but the proportion of the contaminated water being removed by it cannot be determined accurately although it probably is large. The map showing the general pattern of ground-water flow lines in the Patuxent formation (Pl. 7) indicates that pumping in the Harbor district removes most of the contaminating water; but a part moves to the Highlandtown district where the water is already contaminated, and a part may be moving toward the Dundalk and Fairfield districts. However, the flow lines are only approximate, and additional information may show that the pattern of flow is different in this part of the area than is shown in Plate 7. Even though it is possible that some of the contaminating water is moving toward the industrial districts southeast of the Harbor district, its rate of advance is so slow that it has not reached them. As was described in the section "Movement of Ground Water," many years would be required before salt water could move from the Harbor district to the Dundalk district. The flow lines on Plate 7 indicate, however, that the degree of contamination in the Patuxent formation, in the southeastern part of the industrial area, due to encroachment will never be as high as it is in the Harbor and Canton districts. This is because all or a large part of the water pumped from the other districts is derived from areas northeast and southwest of the source of contamination (Patapsco River estuary). The Highlandtown, Dundalk, and Fairfield districts probably are more directly exposed to the contamination than are the Curtis Bay and Sparrows Point districts, in which practically all the water pumped from the Patuxent formation moves into the districts from a relatively great distance from Baltimore, and which appear to be relatively safe from this contamination so long as the present pattern of pumping in the area is continued.

If the pumping from the Patuxent formation in the Harbor district is decreased appreciably or stopped the rate of growth of the contaminated area will increase. Consequently, so far as salt-water contamination in the Patuxent formation is concerned, it would be advisable to continue the pumping in the Harbor district. Fortunately a few of the industries in this district appear to have found it practicable to continue use of ground water, even though the water is highly mineralized. Unfortunately there is no appreciable pumping in the western part of the Canton district, as this would also aid materially in removing the contaminating water.

PATAPSCO FORMATION

Owing to the large area in which it is exposed to the Patapsco River estuary, the Patapsco formation is much more susceptible to salt-water contamination than the Patuxent formation. Heavy pumping from this formation has caused a relatively large area of contamination, and as the water levels in wells ending in the Patapsco formation are below the level of the estuary in a large part of the industrial area, salt water is still entering the formation.

The lower part of the Patapsco formation is partly protected from salt-water encroachment by a clay bed chiefly in the Sparrows Point and Curtis Bay districts. Thus, in the Sparrows Point district, which is the center of heaviest pumping from the Patapsco formation, the lower part of the formation is generally less contaminated than the upper part. In the southeastern part of the district, however, well logs indicate that the clay bed may pinch out. Consequently, pumped wells ending in the lower part of the Patapsco formation in the Sparrows Point district may draw a part of their water from the upper part of the formation; this would account for the high chloride content of the water in these wells. For example, it is possible that the salt-water contamination in well Bal-Gf 175, in the public-supply well field at Sparrows Point, is caused by ground-water flow from the upper to the lower zone. Furthermore, the high chloride content of the water from well Bal-Gf 137 (Bethlehem Steel Co. well Coke Oven 29) may be due to such movement and not to leakage through defective casing as was thought. The practice of pumping well Bal-Gf 137 in order to prevent salt water from moving northwest across the district is worthwhile, for it may be an effective means of delaying the spread of contamination in the lower part of the Patapsco formation in the district. Consideration should be given also to pumping water from the upper part of the formation in the southeastern part of the district in order to decrease its hydrostatic head as it may decrease ground-water movement from the upper into the lower zone.

This brief account of protective pumping in the Sparrows Point district shows how the spread of contaminating water may be retarded effectively. However, the hydrologic and geologic conditions in the Baltimore industrial area are so complex that the conditions at each locality should be thoroughly known before attempting protective pumping. It is not practicable to give all the available information for each locality in this report; but, this information may be obtained at the Maryland Department of Geology, Mines and Water Resources. The salinity in the lower part of the Patapsco formation will never be as high as the salinity of water in the Patapsco River estuary. The piezometric contours shown in Plate 14 indicate that a large part of the water pumped from that zone in the Sparrows Point district is derived from parts of the area a long distance from the sources of contamination, so that the salt water that enters the formation is diluted by inflow of fresh water. The localities where contamination will be most severe cannot be readily determined as the irregularity of the sand and clay beds in the Patapsco formation makes it practically impossible to determine the precise pattern of ground-water flow from the Patapsco River estuary into the formation. Moreover, the bed of the estuary has been covered extensively with silt (Gottschalk, 1944), so that in some places the movement of salt water into the formation may be retarded. Intermittent dredging for maintenance of the ship channel to the Baltimore harbor, however, probably removes some of the silt for a time, so that the susceptibility of the Patapsco formation to salt-water contamination may vary somewhat in accordance with the dredging.

With the present distribution and rate of pumping the contaminated area probably will not expand much beyond its present size (Pl. 16), but the salinity may increase gradually at some localities within the contaminated area.

Contamination to the Patapsco formation could be prevented by stopping all pumping from the formation; however, other factors, discussed later in this report, must be considered before concluding that such a step would be advisable.

PLEISTOCENE DEPOSITS

The lower unit of the Pleistocene deposits, which in a large part of the Baltimore industrial area probably is hydrologically connected with the Patapsco formation, may be considered as being a part of that formation when considering salt-water contamination in that area; in most places salt water that enters the Patapsco must pass through Pleistocene deposits. Consequently, the general features of the salt-water contamination of the Patapsco formation also apply to the Pleistocene deposits.

FACTORS AFFECTING THE SPREAD OF THE ACID-CONTAMINATED AREAS

The acid contamination, which is chiefly in the shallow aquifers (Patapsco formation and Pleistocene deposits) above the Arundel clay in the Canton district, apparently has not expanded appreciably. According to the piezometric contours of the Patapsco formation (Pl. 14), there is little movement of water within this aquifer southeastward from the Canton district; the configuration of the contours indicates that the main aquifer in the lower part of the Patapsco formation may be absent in the Canton district. Thus the present rate and distribution of pumping probably will not cause any appreciable expansion of the acid-contaminated area within the Patapsco formation.

In some parts of the Canton district the acid water in the shallow aquifers leaks downward through defective wells and has contaminated the Patuxent formation. As there is little pumping from the Patuxent formation in these parts of the Canton district, the acid water may move away from that district, through the Patuxent formation, to nearby centers of pumping. In this manner highly acid water has moved northward to the well field of the Crown Cork and Seal Co. in the southern part of the Highlandtown district. Acid water could move also southeastward to the center of pumping in the Dundalk district, but at present no wells in that district yield acid water. The general pattern of ground-water flow lines in the Patuxent formation (Pl. 7) indicates that a part of the water pumped from the Patuxent formation in the Dundalk district moves across the Canton district, and therefore a part of the water flowing into the Dundalk district may be contaminated. The time required for water to move from the Canton district to the Dundalk district is many years, so that there may not have been sufficient time since the existing pattern of flow lines was established, for the acid contamination to reach the well fields in the Dundalk district. It also is possible that the general pattern of flow lines shown in Plate 7 is not accurate and that practically all the acid contamination moves northward to the Highlandtown district. If the pumping in the southern part of the Highlandtown district is ever decreased appreciably or stopped, it is reasonably certain that acid contamination would move southeastward toward the Dundalk district and would eventually reach at least some of the centers of heavy pumping. However, the degree of contamination probably would not be as severe as in the Canton district, for a large part of the water pumped in the Dundalk district is derived from areas that are not contaminated.

With the present rate and distribution of pumpage it is not likely that the Fairfield, Curtis Bay, and Sparrows Point districts will ever be seriously contaminated with acid originating in the Canton district.

The most effective means of decreasing the contamination by acid is by plugging abandoned wells in the Canton district and by pumping wells at certain strategic localities in that district that draw water from the Patuxent formation and from the shallow aquifers above the Arundel clay. The pumping from the shallow aquifers would decrease the difference in hydrostatic head between those aquifers and the Patuxent formation, thereby lessening the inflow of contaminated water to the Patuxent formation. The pumping of water from the Patuxent formation would remove at least some of the contaminated water and would form a cone of depression within the district, helping to prevent the acid water from moving outside the district.

MINERAL CONTAMINATION OF GROUND WATER THROUGH LEAKING WELLS

One of the most serious ground-water problems in the Baltimore industrial area is the mineral contamination of ground-water supplies through leaking wells. Most of the major well fields in the industrial area are being contaminated in this manner.

A large part of the contaminating water moves through defective wells that penetrate the shallow contaminated aquifers above the Arundel clay (Pl. 16) and extend through the Arundel clay into the Patuxent formation. Owing to the difference in artesian head between the shallow aquifers and the Patuxent formation in most parts of the area, wells screened in the Patuxent whose casings have been corroded opposite the shallow aquifers may conduct highly mineralized water downward to the Patuxent formation. In some parts of the area, chiefly the Sparrows Point district, the lower part of the Patapsco formation also has been contaminated by wells conducting salt water from the upper part of the Patapsco formation and the Pleistocene deposits.

The casing in some wells, drilled many years ago, probably developed holes through gradual deterioration and structural collapse even though the water in contact with the casing may not have been high in mineral content. The corrosion of many casings, however, was hastened by the presence of salt water through local encroachment in the Patapsco formation and Pleistocene deposits. A sizable part of the land adjacent to the Patapsco River estuary has been built up artificially through the dumping of earth fill, slag, etc., along the banks of the estuary (fig. 24). It probably would require many years for the salt water in this material to be flushed out by natural circulation of water from precipitation; so that the casings of many wells in these areas of artificial land are susceptible to corrosion.

Stray electrical currents in the ground in the industrial area also may cause holes to develop in the well casings. During the electrical logging of well Bal-Gf 193 (Sparrows Point district) strong surges of current, having a potential of as much as 500 millivolts, were measured at depths below 180 feet. The casing of a well might short circuit the current between horizons at which there are stray currents at different potentials. Holes might eventually form at the places where current leaves the casing.

During recent years many of the large industrial wells were drilled by the rotary method, in which the diameter of the drilled hole was several inches larger than the diameter of the casing installed. Some of these wells were not cemented as it was thought that clay would flow into the annular space outside the casing. Measurements of a rotary-drilled hole show that the diameter may be larger in clay than in sand. Hole-diameter measurements in well Bal-Gf 194, Sparrows Point district (Pl. 11), show that in general the diameter is larger opposite the tough red clay that separates the Patapsco formation into upper and lower parts. As this clay is similar to the Arundel clay, there may be an annular space opposite the Arundel clay outside the casing of some wells. It is possible, therefore, that the major confining beds of clay are not sufficiently plastic, in all localities, to squeeze tightly against the casing and prevent vertical movement of ground water along the outside. According to Geyer (1945, p. 56), open channels have developed along smooth conduits penetrating embankments in earth dams. He adds that, "If it has been found that leakage along pipes through dams cannot be prevented with certainty by tamping impervious clays around them, it is not hard to believe that leakage will frequently occur outside well casings that are set in holes of unknown diameter, with a single uncertain seal at the bottom, and subjected to head differences of some 200 feet between the upper and lower formations."

As contamination through leaking wells is one of the most serious ground-water problems in the industrial area, an attempt was made to determine the location and constructional record of all drilled wells in the Baltimore industrial area. As wells have been drilled in the industrial area for about 100 years and many of the companies have changed ownership several times, it is likely that many wells have been drilled for which no information was obtained. It is estimated that about 1,500 wells have been drilled in the industrial area, and some record was obtained on about 85 percent of them. Of the total of 1,500 wells 1,140 are no longer accessible, many being covered by buildings, pavement, debris, earth, fill, etc. Of the 360 wells that are accessible, 160 are used or are equipped for use. The estimated number of wells that are considered abandoned, in 1945, is 1,250 and of these only about 150, or about 12 percent, are plugged. Not all the unplugged abandoned wells are conducting salt water to fresh-water-bearing formations, however, for some of these wells are (1) in parts of the area where there is no salt water, (2) some are finished in shallow aquifers and therefore cannot conduct water to the deeper aquifers, (3) some are in the Harbor district where the Patuxent formation is contaminated anyhow by encroachment from the Patapsco River estuary, so that plugging wells would not prevent contamination, and (4) some old wells have been plugged through collapse and disintegration of the casing permitting the well to become filled with sand and clay. Nevertheless, there are many wells, some in use and others abandoned, that have not been repaired or plugged, that probably are conducting highly mineralized water to fresh-water-bearing formations.

Highly mineralized water can be conducted through a well only if the head of the salt water is higher than that of the fresh water. At present the head in the Patapsco formation is higher than the head in the Patuxent formation (Pls. 13 and 14); moreover, in the Sparrows Point district the head in the upper part of the Patapsco formation (fig. 16) is higher than that in both the lower part of the Patapsco formation and the Patuxent formation. Thus within the area of contamination in the Patapsco formation highly mineralized water may be conducted through leaking wells to the Patuxent formation; and, chiefly in the Sparrows Point district, the lower part of the

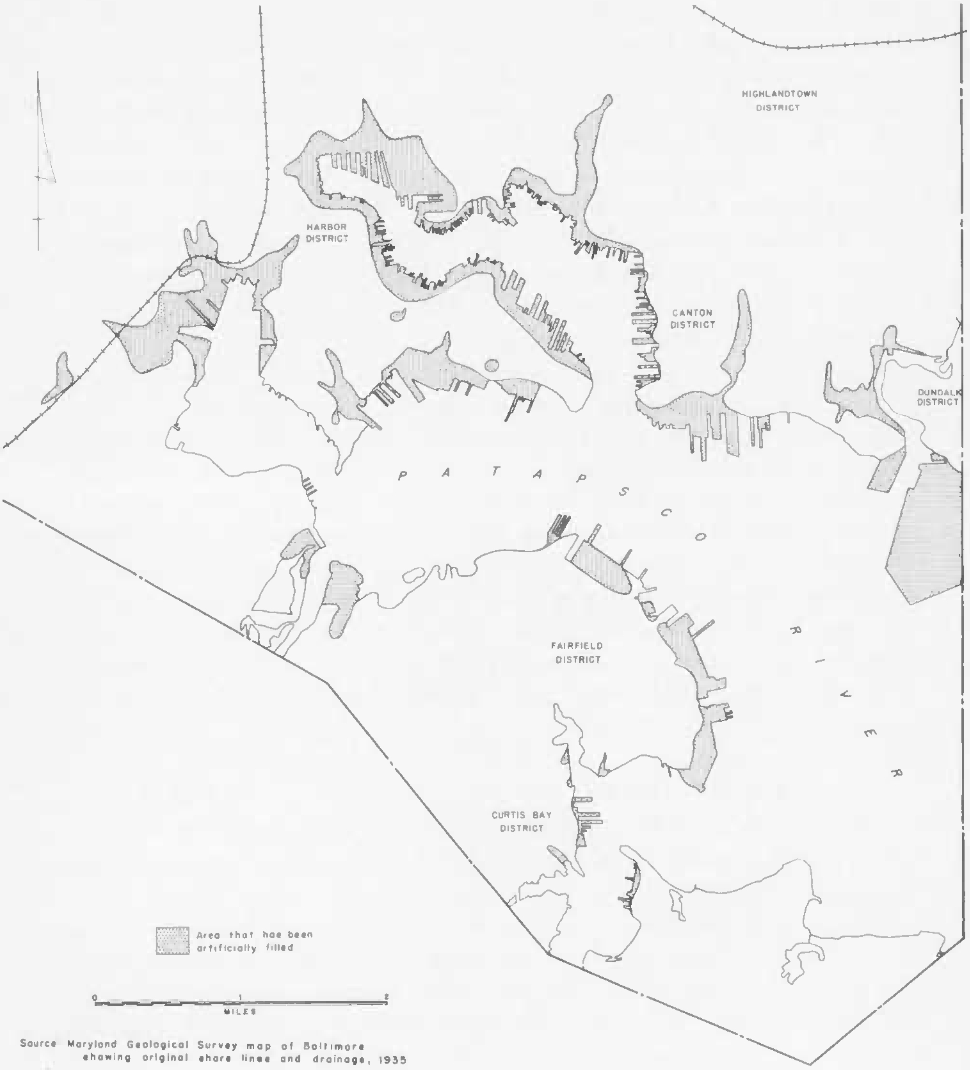


FIGURE 24. Map of the southern part of Baltimore showing the location of the original shore line

Patapsco formation, which is partly protected by a fairly extensive clay bed, may be contaminated by leakage through wells from the upper part of the Patapsco formation and from the Pleistocene deposits.

In a large part of the industrial area ground-water supplies were first developed from the shallow aquifers, chiefly the Patapsco formation, and for a time the artesian head in the Patuxent formation generally was higher than the head in the Patapsco formation. Through overpumping, the water in the Patapsco formation became contaminated with salt water from the Patapsco River estuary and many wells drawing water from the Patapsco formation were abandoned and were replaced with wells drilled to the Patuxent formation. The reduction of pumping from the Patapsco formation and increase in pumping from the Patuxent caused the head in the Patapsco formation to be higher than that in the Patuxent formation, so that contaminated water could flow through defective wells from the Patapsco formation to the Patuxent formation. Thus it has not been until recent years, when pumping from the Patapsco formation was decreased, that defective wells caused serious contamination in the Patuxent formation.

Highly mineralized water can leak through or down the outside of the casings of wells in an exceedingly complex manner; a few examples are shown schematically in Figure 25. The manner in which salt water leaks should be known before a well is repaired or plugged; hence, careful study of the construction record of the well and field tests are necessary. Many such tests were made but examples of only a few of these are included in this report (figs. 26 and 27). Some of the field tests require the use of special instruments that may not be readily available to industries or other well owners in the area, but tests in which special instruments are not needed are often adequate to determine the location of a leak in a well. Most of the methods of locating salt-water leaks have been described in detail by Livingston and Lynch (1937).

METHODS OF TESTING FOR SALT-WATER LEAKS IN WELLS

Four methods of locating salt-water leaks were used during the investigation, (1) the pumping-test method, (2) the electrical-conductivity method, (3) the sampler method, and (4) the velocity method.

The pumping-test method consists of pumping a well and determining the change in chloride content of the water discharged. The well is usually shut down for several hours, then the well is pumped and samples of water are collected every few seconds for several minutes, and at increasing time intervals as the test progresses. The chloride content of the water in the samples can be determined readily with a field outfit using silver-nitrate and potassium-chromate solutions. The chloride content is plotted against time. The time may be plotted on a logarithmic scale in order to condense the graph to a reasonable size.

The shape of the chloride curve usually indicates whether the contamination is caused by direct leakage through the casing of the well, leakage through nearby wells, or lateral encroachment of salt water into the fresh-water aquifer. Ordinarily if the chloride content does not change significantly during the test the contamination probably is either from distant leaking wells or from a

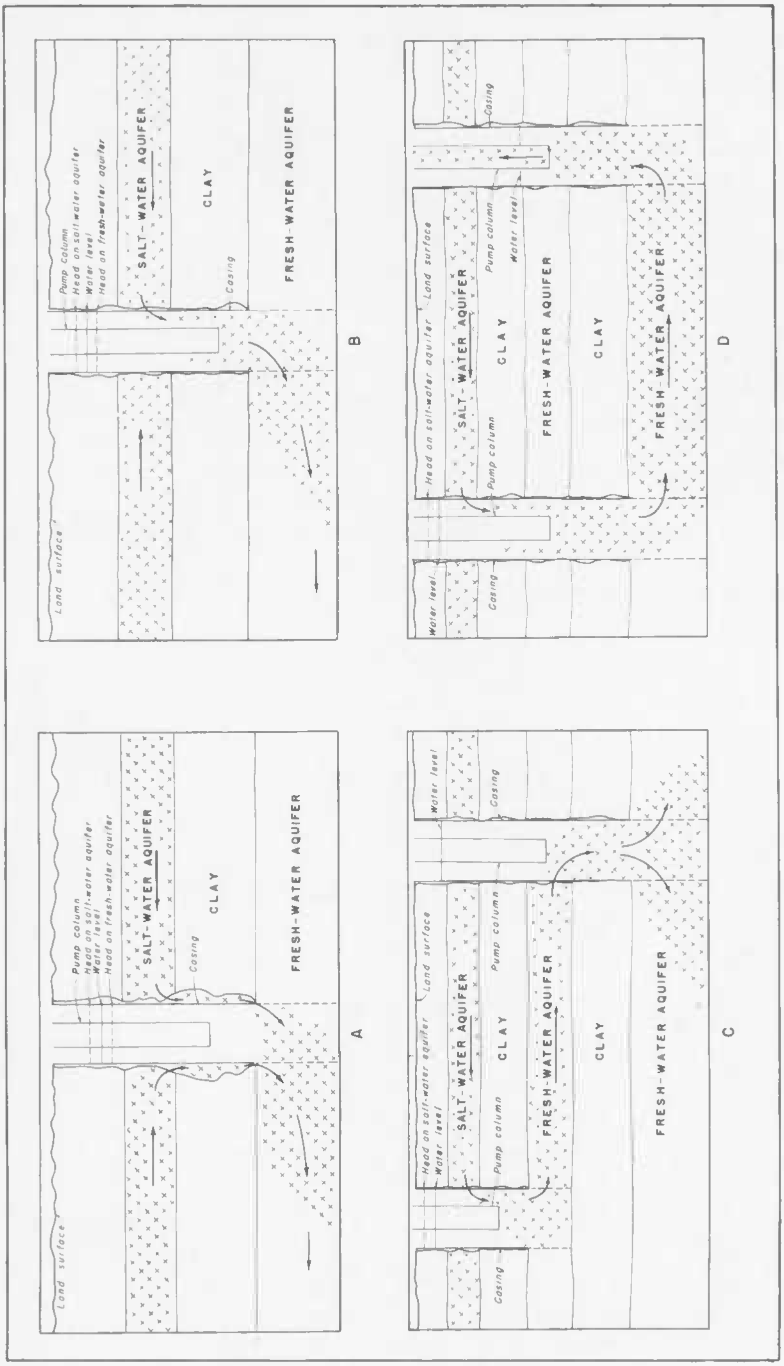


FIGURE 25. Diagram showing how fresh-water aquifers may be contaminated with salt water through wells

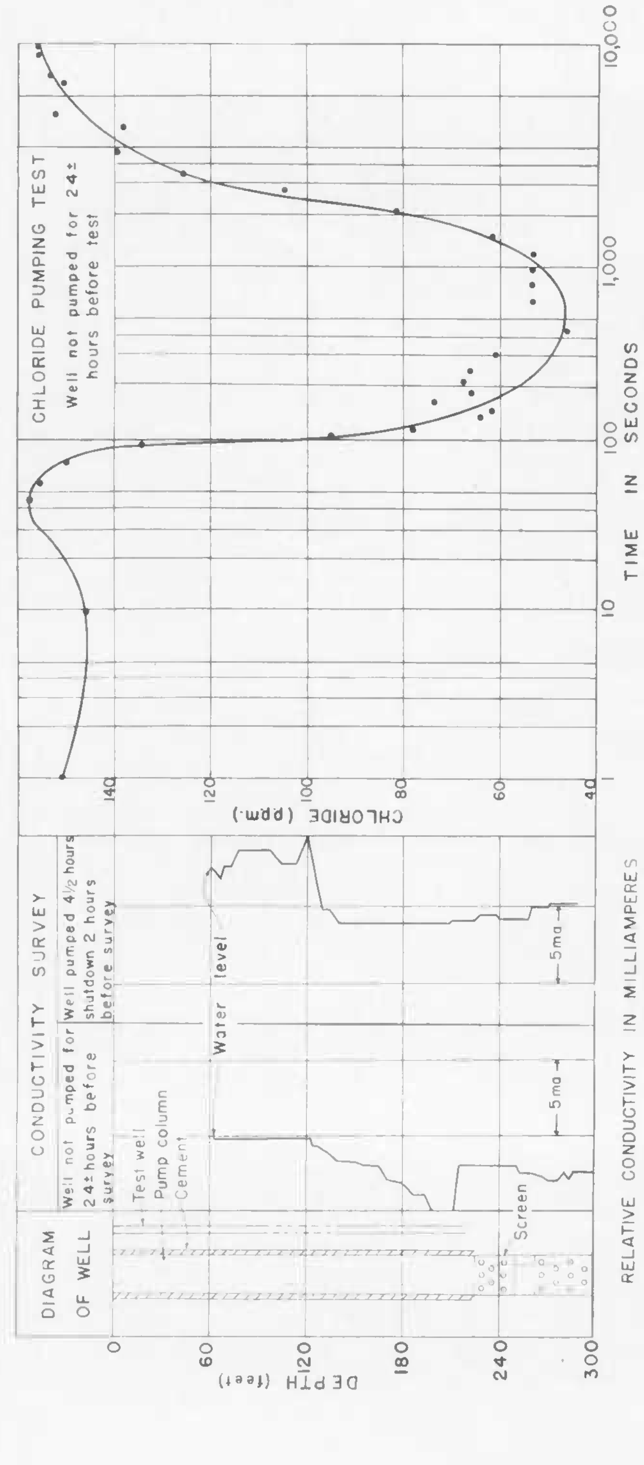


FIGURE 26. Graph showing salt-water contamination of well 3S4E-2 caused by leakage from nearby test well

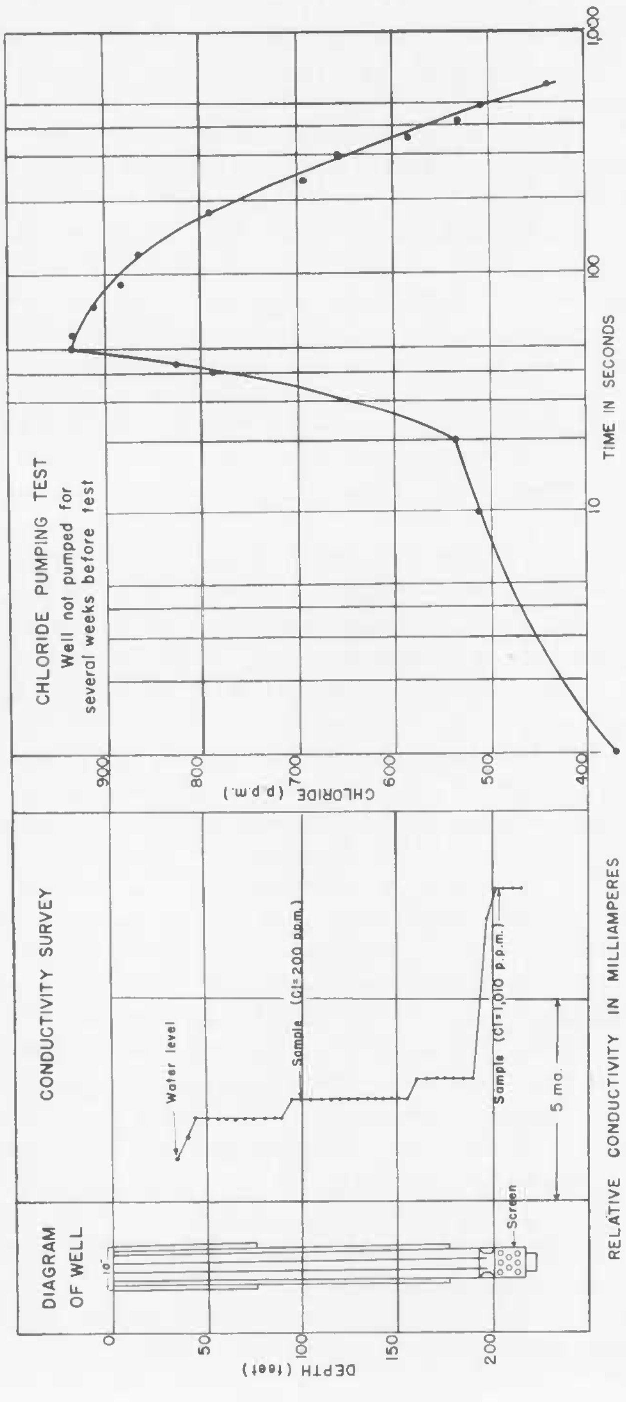


FIGURE 27. Graph showing increase in chloride content of water at bottom of well Bal-Gf 166

formation that has been contaminated by lateral encroachment of salt water. A sharp change in the chloride content indicates that either the pumped well or nearby wells are leaking. In wells that are leaking salt water through an opening in the casing below the bottom of the pump column, the approximate depth to the leak can be determined by measuring the volume of water pumped before the chloride rises abruptly and computing the depth in the well equal to this volume. In order to determine the depth with reasonable accuracy it is necessary to know the volume per foot of the pump column and casing, and the quantity of water withdrawn from the space between the pump column and the casing during the period of pumping prior to the sharp rise in chloride. Even under the best conditions this method of computing the depth to a salt-water leak below the bottom of the pump column may be correct only to a general order of magnitude. In several pumping tests in the Baltimore area, however, it was noted that the sample of water that came from the bottom of the well contained sediment or was turbid; this provided a reference level for computing the approximate location of salt-water leaks in the wells.

If a well has a salt-water leak in the casing, the maximum content of chloride determined by the pumping-test method probably is nearly equal to the chloride content of the contaminating water; with this figure the approximate rate of leakage may be determined. For example, if a well originally yielded water containing 10 parts per million of chloride but after developing salt-water leaks it yields, at a pumping rate of 100 gallons a minute, water containing 40 parts per million chloride and the pumping-test method shows a peak chloride content of 1,400 parts per million, the proportion of contaminating water would be $^{30}/_{1400}$ or 2.1 percent. Thus the leakage is 2.1 percent of 100 gallons a minute or about 2 gallons a minute.

It is difficult to list criteria for interpreting chloride curves obtained by the pumping-test method. Generally it is necessary to study the construction record of the well, then to list all ways in which the well could be contaminated and then to run pumping tests, sometimes with different periods of shut-down before pumping. If the chloride curve shows an abrupt rise shortly after pumping starts and before water from near the bottom of the well reaches the surface, salt water probably is leaking into the well through an opening in the casing. If the chloride rises abruptly at the same time water from near the bottom of the well reaches the surface, salt water probably is leaking down the outside of the casing. If the chloride curve shows a more gradual increase and the time of the increase indicates that the salt water is from outside the well, some nearby well probably is leaking. One pumping test was made in the Highlandtown district to determine if a well was being contaminated by leaking of acid water. The same principles described for salinity pumping tests apply in the tests for leaking of acid water, except that, instead of the chloride content, the acidity (pH) of the water is determined, by means of a field pH meter.

The rather general statements concerning the interpretation of the pumping test data cannot be considered infallible. Several factors affect the character of the chloride curve, and it is only through careful reasoning and with the help of supplementary tests that the manner in which highly-mineralized water leaks through wells can be determined accurately.

The electrical-conductivity method of testing for salt-water leaks is based on the fact that the electrical conductivity of water increases in proportion to its content of ionized substances in solution. As the contaminating water in the Baltimore industrial area is composed chiefly of sodium chloride (salt), the conductivity increases with an increase in salinity. Several types of apparatus have been used in the United States to measure the conductivity, or the resistivity, of water in water wells (Poland and Morrison, 1940, pp. 35-46; Livingston and Lynch, 1937, pp. 12-19), but all are fundamentally alike. The apparatus consists essentially of two electrodes attached to the end of an electrical cable; the electrodes are lowered in a well and the conductivity, or its reciprocal (resistivity), of the water between them is determined either by use of a milliammeter or a Wheatstone bridge. The equipment constructed and assembled for use in the Baltimore area was first equipped with a non-recording milliammeter, but in order to achieve greater accuracy and speed a recording milliammeter was installed later.

The electrical-conductivity method has the advantage of locating the position of salt-water leaks more accurately than the pumping-test method, and in some wells is especially useful to survey the condition of the well above the bottom of the pump column; moreover, as it is not necessary to determine the chloride content of the water by chemical analysis the method requires much less time than the pumping-test method. Ordinarily a well must be pumped for a period of time and then shut down for a few hours before running a conductivity survey; consequently it usually is practicable to employ both the pumping test and conductivity survey on the same well. If the well is not equipped with a pump it may be necessary to discharge fresh water into the well for several hours in order to condition it for a conductivity survey.

The conductivity, expressed in milliamperes, is plotted against the depth in the well at which measured. Examples of conductivity curves are included in Figures 26 and 27.

The sampler method, which was used primarily in conjunction with the other methods, consists merely of collecting samples of water at different depths in the well and determining by chemical means the chloride content of the water. The samples were collected with a sampler, designed and constructed by Penn Livingston of the United States Geological Survey. The sampler consists of a 2-inch-diameter pipe with leather flap valves in the upper and lower parts. This container is lowered in the well by means of a cable and winch, to the desired depth, and then the cable is jerked several times so that the container moves rapidly up and down through a distance of about 3 feet. This movement alternately opens and closes the flap valves allowing water to enter the container. As the container is pulled out of the well the flap valves close tightly and prevent water from either escaping or entering. The chloride contents of water samples, collected with this sampler, are included in Figure 27.

The velocity method of determining salt-water leaks uses a sensitive Au deep-well current meter. The current meter consists essentially of a turbine wheel mounted on bearings in a metal cylinder. The upper part of the axle of the turbine is so designed that at each revolution it makes electrical contact with a small spring wire. The meter is placed in a 3-foot metal tube for protection and is lowered in a well by means of a cable and winch. The meter is connected electrically through the cable to a dry cell and earphones at the land surface. At each revolution of the turbine wheel the circuit is closed, causing a click in the earphones. By counting the number of revolutions of the meter per minute, or some other period of time, the velocity at which water is moving in the well may be computed from rating tables prepared empirically by the National Bureau of Standards (1934). By use of the current meter the rate at which salt water is leaking into a well and the location of the leak may be determined. Although the deep-well current meter was used extensively in the Baltimore area, it generally was successful only in wells not equipped with pumps.

Another method of testing for salt-water leaks, which is used successfully in the Baltimore area by the Shannahan Artesian Well Co., consists of first plugging the screen of a well with fine sand and then discharging water into the well at a uniform rate while progressively filling the well with sand. The fine sand prevents water from flowing downward and out the screen; consequently, if a well takes in water with the screen plugged the casing contains one or more openings. Progressively filling the well and noting the change in the rate at which water is taken in enables the depth of the openings to be determined. After the test is completed the sand in the well is readily forced out by circulating water or air through a small-diameter pipe.

Another method of locating leaks in wells but one that has not been used in the Baltimore area is the temperature method. This consists essentially of measuring the temperature gradient in a well by use of a sensitive electrical-resistance thermometer. In a well that is not leaking the temperature would increase progressively with increasing depth. However if water is leaking from a shallow aquifer and moving down the well either inside or outside the casing, the temperature gradient may be decreased appreciably in the depth interval in which the cooler water is moving. By noting the level at which the temperature gradient changes, the depth of the leak may be determined.

Other methods that use photoelectric cells or geophones have been applied in other areas, chiefly for detecting leaks or movement of extraneous fluids in oil wells, but these methods generally would not be practicable for testing salt-water leaks in water wells in the Baltimore area.

In testing for the cause of salt-water contamination in wells it usually is necessary to keep in mind the local hydrology and geology, as well as any other factors that might have some effect on the origin and movement of salt water into the wells. For example, some of the tests made on well 3S4E-2 (Dundalk district), shown in Figure 26, are difficult to interpret without knowledge of the geology and hydrology of the locality and the repair work done previously on the well. In 1941 the ground adjacent to the well subsided and simultaneously the chloride content of the water from the well increased to more than 100 parts per million. Several small-diameter test wells were drilled around the well and a cavity was encountered in one boring at a depth of about 100 to 175 feet; 44½ tons of gravel was poured into this cavity. As further protection against contamination, a slurry made with 595 bags of cement was pumped under high pressure into a test boring extending to a depth of about 80 feet. Apparently the filling of the cavity and the cementing operation were partly successful, as the chloride content of the water from the well is reported to have decreased to about 35 parts per million. Some time after these repairs were made the chloride content increased again and in October 1945 it was about 150 parts per million. In order to determine the cause of this contamination two electrical-conductivity tests and a pumping test were run on October 29, 1945 (fig. 26).

Well 3S4E-2 is about 300 feet deep and is screened in a part of the Patuxent formation at depth intervals of 234 to 249 feet and 264 to 294 feet. The thickness of the geologic formations penetrated by this well cannot be determined accurately from the available well logs, but the Pleistocene deposits probably extend from near the land surface to a depth of about 50 feet; the Patapsco formation from about 50 to about 125 feet; the Arundel clay from about 125 to about 200 feet; and the Patuxent formation from about 200 to about 400 feet. The pump column extends to a depth of 276 feet. At the time of the tests, the static water level was 62 feet below the land surface. As the well contained a pump, the electrical-conductivity tests necessarily were run between the pump column and the casing. The first test was run after the well had been shut down for about 24 hours. It shows that the salinity of the water, between the pump column and the casing, was relatively high from the water level at 62 feet to a depth of 122 feet; it then progressively decreased to a depth of 214 feet; then increased abruptly and remained moderately high to the bottom of the well. After this test the well was pumped for 4½ hours, during which time samples of water for chloride tests were collected periodically. These analyses show that the well yielded water containing about 150 parts per million of chloride for about 1½ minutes, then yielded water containing 50 to 70 parts per million chloride for about 30 minutes, after which the chloride content gradually increased, reaching about 150 parts per million after 2 hours pumping.

The well was shut down for 2 hours and then another electrical-conductivity test was run to see if the pumping had caused any change. This test showed that the salinity of the water between the pump column and casing was relatively high from the water level to a depth of about 120 feet, then decreased sharply and remained relatively low to the bottom of the well. It is not clear why the second conductivity test differed so much from the first test, when the movement of water through the well due to pumping, except the water displaced by the lowering of the static level, is through the pump column and not through the space between the pump column and the casing. Presumably after about 24 hours, the conductivity curve of another test would be about the same as the curve obtained in the first test. A comparison of the two curves indicates that, during pumping, the interval below a depth of about 120 to 140 feet was freshened. This might be caused by a slight leak in the pump column allowing fresher water to escape and move downward in the well. The relatively high salinity from the water level to a depth of about 120 feet may be caused by a very small leak through the casing above 60 feet, perhaps from the Pleistocene deposits; and the abrupt increase in salinity at about 214 feet also may be caused by a leak in the casing.

A leak at this level would be opposite the Patuxent formation, which should not contain high-chloride water, but it is possible that saline water might move downward through one of the test borings to this level and then enter the well through an opening in the casing. Although the electrical-conductivity tests indicate small salt-water leaks through the casing of the well, most of the contamination probably originates in either the Pleistocene deposits or the Patapsco formation and moves down the deep test boring, which is about 10 feet from well 3S4E-2, and enters the aquifer screened in that well.

The salinity pumping test confirms this conclusion. The high-chloride water pumped during the first 1½ minutes of the test is from within the pump column; as soon as water from within the aquifer enters the well the chloride content decreases and remains low until water from a distance of about 10 feet, the distance to the test boring, reaches the well; then the chloride content of the water pumped increases gradually. The decrease in chloride, after the water in the pump column is pumped out, indicates that the water in the aquifer close to the well was freshened during the 24-hour period of shut-down. The freshening probably was caused by the movement of water through the aquifer toward well 3S5E-11, which is about 1,000 feet to the southeast. Well 3S5E-11, which was pumped heavily for many days prior to the tests on well 3S4E-2, would have formed a cone of depression so that water would flow through the aquifer past well 3S4E-2, thereby causing the contaminating water from the test boring to move toward well 3S5E-11 rather than accumulate around well 3S4E-2. As soon as well 3S4E-2 is pumped a cone of depression is formed around it and, owing to the steep hydraulic gradient near the well, the contaminating water moves quickly and enters the well.

This summary of the problem of salt-water contamination in well 3S4E-2 is an example of the difficulty of diagnosing the manner of leakage and source of contamination in some wells and the importance of considering all factors that may affect the leakage. Despite the complex manner in which wells may be contaminated by leakage, the location of the leaks and the source of the highly-mineralized water generally can be determined.

Fortunately, the contamination in many wells in the industrial area is caused solely by leaks through the casing, and generally in this manner of contamination can be readily determined. Examples of tests made on a well contaminated by leakage through the casing are shown in Figure 27. The well, Bal-Gf 166 (Sparrows Point district), was equipped with an air-lift pump and it was necessary to make the electrical-conductivity test within the discharge pipe; as the discharge pipe extended to the lower part of the well, the exact levels at which salt water was leaking could not be detected. The sharp increase in conductivity of the water just below the discharge pipe shows that salt water is leaking in the well through the casing. The locations of these leaks could be determined by removing the discharge pipe and making a conductivity test. The salinity pumping test also indicates that salt water had accumulated around the well from leaks through the casing; after the well was pumped about 10 to 15 minutes practically all this contaminated water was removed.

In some wells the water-bearing beds containing high-chloride water are not directly opposite the leaks in the casings, for some tests showed that salt water was moving down the outside of a casing and then entering the well at a lower level.

SUMMARY

In summary, the salt and acid contamination of wells and fresh-water aquifers through leaking wells is one of the most serious ground-water problems in the Baltimore industrial area. Most of the major well fields in the industrial area are being contaminated to some extent in this way, and many unplugged abandoned and covered wells are leaking highly mineralized water. Contamination from leaking wells is possible in any part of the area in which the sediments above the Arundel clay are contaminated (Pl. 16).

The quantity of highly mineralized water leaking into the fresh-water-bearing formations is not known but probably is not large when compared to the quantity of water pumped from the industrial wells. Nevertheless, a very small quantity of highly mineralized water entering a well may make the water pumped from the well unsatisfactory for certain industrial uses.

The quantity of contaminating water leaking through wells depends not only on the number and size of the openings in the casings or along the outside of the wells, but also on the difference in hydrostatic head between the highly mineralized aquifer and the fresh-water aquifer. Other things being equal, the contamination through leaking wells in the industrial area will be greater with an increase in pumping from the Patuxent formation or a decrease in pumping from the Patapsco formation.

The only practicable method of eliminating contamination through leaking wells is to determine the location of the leaks and to repair the wells by cementing or by reconstructing the defective part of the well and by plugging abandoned wells. Industries in the Baltimore area realizing the seriousness of contamination through leaking wells have repaired some production wells and have plugged some abandoned wells, but many well fields contain old abandoned wells, some of which are covered, that are not plugged and that may be leaking. The maps showing the locations of wells (Pls. 1, 3, and 4) include those wells which, according to available data, were not plugged in 1945. Many of the abandoned wells will be plugged in the near future; for example, the Bethlehem Steel Co. in the Sparrows Point district is engaged in a program of repairing all leaking production wells and plugging old abandoned wells. If this is done in all the active well fields in the industrial area where there is contamination through leaking wells the major part of contamination through wells probably would be eliminated. There remain, however, many wells in old abandoned well fields, chiefly in parts of of the Harbor and Canton districts, that should be plugged in order to prevent or decrease the spread of contamination from these old well fields.

Another method by which contamination through leaking wells may be prevented or materially reduced is protective pumping. In many well fields this is being done, perhaps unintentionally, for pumping from some wells diverts contaminating water and prevents it from reaching other wells. In the Sparrows Point district, pumping from the upper part of the Patapsco formation will eventually increase the salinity of the water in this aquifer in the district; however this pumping decreases the leakage of water through wells to lower aquifers. In other parts of the industrial area contamination of the Patuxent formation through wells could be materially reduced by pumping from the Patapsco formation, but such pumping should be considered only as a last resort, as it would increase the salinity in the Patapsco formation through local encroachment.

Pumping of water at certain localities in the Canton district, from the shallow aquifers and perhaps for a time from the Patuxent formation, might remove a large part of the acid that has contaminated the aquifers there and prevent the spread of contamination from the Canton district thereby eventually decreasing the acidity of the water in the southern part of the Highlandtown district. Moreover, this protective pumping would prevent acid water from moving southeastward from the Canton district, if such movement is taking place. Before such a plan is put into effect, it would be desirable first to plug all the abandoned wells that can be located.

TEMPERATURE OF GROUND WATER

One of the most important uses of ground water in the Baltimore industrial area is for cooling in certain industrial operations. The water is a refrigerant and serves as a means of storing and removing heat. Ground water in this area is well suited for this use because its temperature is generally consistent and is lower than the temperature of surface water in the summer. Figure 28 shows the general range of ground-water temperature with depth. The temperature ranges from about 55° to 64° F. and increases about 1° F. for each 60 feet of depth. Below a depth of about 50 to 100 feet the temperature is not appreciably affected by variations of atmospheric temperature but above this depth the temperature may vary as much as several degrees between winter and summer.

FACTORS AFFECTING THE "SAFE YIELD" OF THE AQUIFERS

The safe yield of an aquifer is generally considered as the quantity of water that can be withdrawn indefinitely without lowering the water levels to uneconomical limits and without impairing the quality of the water. The uses of ground water in the Baltimore area are so diverse that there is little or no uniformity in its economic value and in the chemical quality of the water that can be used. Consequently, the application of the term safe yield, in the sense that it represents a single maximum permissible rate of pumping for the area, would be entirely unrealistic. Although the quantity of water that can be withdrawn safely from an aquifer may be dependent on economic factors, it also depends on the rate of recharge, the transmissibility, and the susceptibility of the aquifer to contamination; it is chiefly to these hydrologic factors that the following discussion is devoted.

CRYSTALLINE ROCKS

The ground-water reservoir formed by the crystalline rocks generally is limited to the outcrop area, where the reservoir, formed by the fractures and

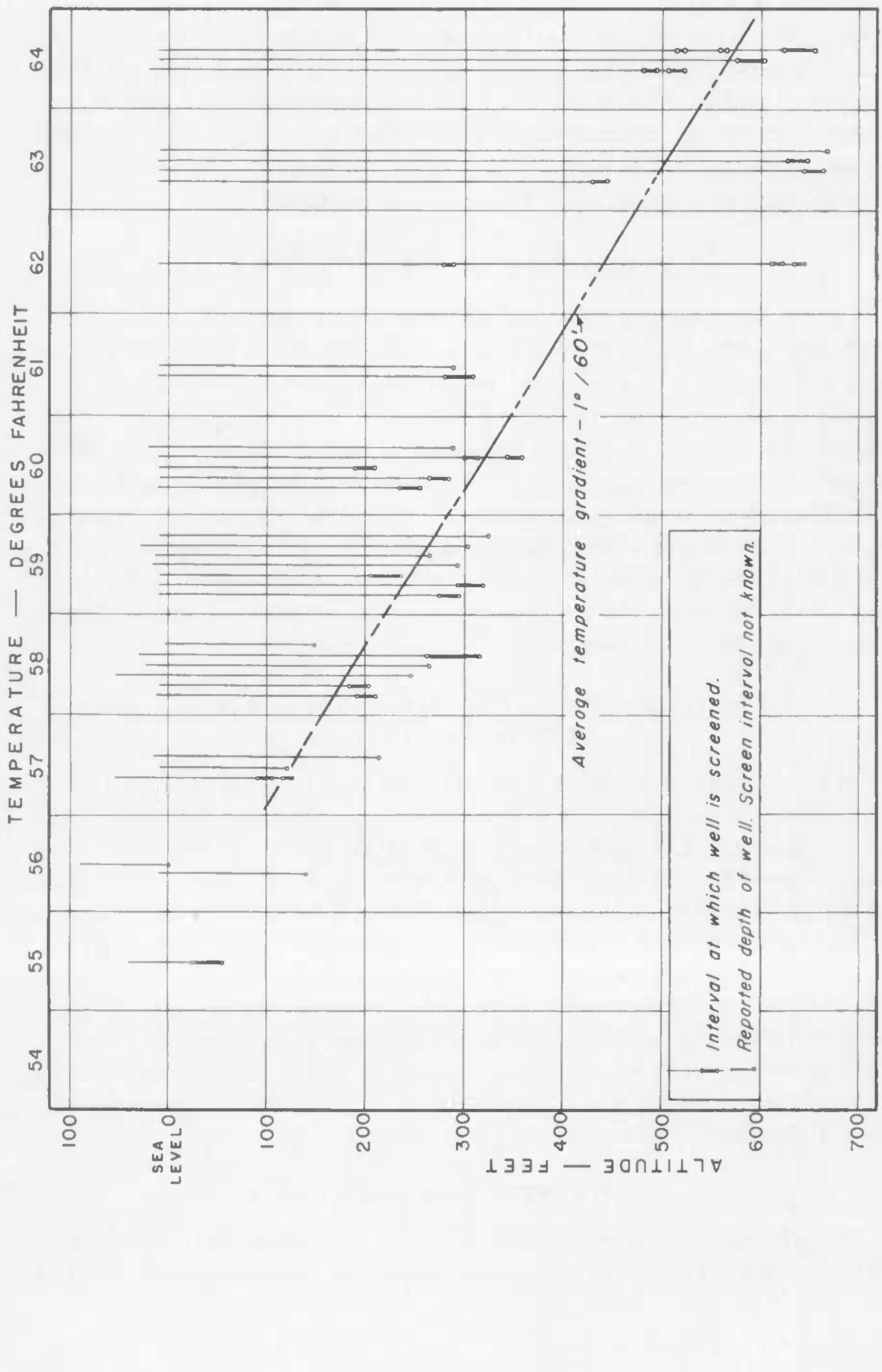


FIGURE 28. Diagram showing the temperature of water from wells in the Baltimore industrial area

other secondary openings in the rocks, is recharged from local precipitation. As streams have dissected the area to levels below the water table, the streams are localities of natural discharge whereas the interstream areas are the localities of recharge. Hence the outcrop area is divided by the streams into many small parts which for most practical purposes may be considered as separate ground-water reservoirs with similar characteristics.

The quantity of water that can be withdrawn indefinitely from these ground-water reservoirs depends chiefly on the quantity of water that is salvaged by the pumped wells from the water that under natural conditions would discharge into the streams. The quantity of ground water that discharges into the streams depends on the quantity of water that enters the reservoir as recharge, which in turn depends on the rate at which water from precipitation enters the ground. That rate fluctuates in part seasonally because of varying demands of evapo-transpiration; hence the quantity of water discharging naturally also fluctuates. Therefore, the safe yield of a ground-water reservoir in the crystalline rocks varies somewhat in accordance with the precipitation. That fluctuation in safe yield is more pronounced in the crystalline rocks than in unconsolidated sediments because the crystalline rocks have a relatively low porosity and are not capable of storing large quantities of ground water.

In a practical sense, however, the most important limiting factor of the safe yield in these ground-water reservoirs is the size and number of the openings in the rocks, which determine the transmissibility. The transmissibility controls the quantity of water that can be transmitted to the pumped wells, and as the transmissibility of crystalline-rock aquifers generally is relatively small, the quantity of water that can be pumped from a well or well field accordingly will be relatively small; it may be considerably less than the quantity of water that could be withdrawn safely from a large number of wells spaced at large intervals throughout the ground-water reservoir.

The development of ground-water supplies from the crystalline rocks in the Baltimore area has not been extensive, and owing to the high cost of development of large supplies the ground-water reservoirs probably will never be utilized to their full capacity. Although the crystalline-rock reservoirs are capable of yielding more water than is being withdrawn from them, pumping from closely spaced wells may cause such excessive drawdowns that ultimately the yield from a well field will not be much larger than the initial yield of one well. In water-bearing material of such low transmissibility it is better to space the wells as far apart as practicable. It is also desirable to place the wells near a stream into which ground water is being discharged naturally, for the nearer the wells are to the area of natural discharge the more quickly is equilibrium established and the less the drawdown in the wells. However the principal limiting factor in the development of water from crystalline rocks is the number and size of openings in them, and therefore preference should be given to those localities where it is likely that the rocks are more permeable; fortunately usually the openings in such rocks are relatively abundant in the areas of natural discharge.

PATUXENT FORMATION

The water withdrawn from the Patuxent formation is derived from recharge on the outcrop of the formation. The water that is added by recharge is transmitted down the dip to localities or areas of discharge. From this it might be supposed that the quantity of water that can be developed from the Patuxent formation is entirely dependent on the rate of recharge; actually, however, there are other limiting factors. The potential rate of recharge to the Patuxent formation in the Baltimore area is not known. Barksdale (1937, p. 16) estimated that about 20 inches of the annual precipitation was available for recharging the Farrington sand member of the Raritan formation in New Jersey; moreover, Barksdale (1943, p. 84) indicates that this figure should also apply reasonably well to the Old Bridge sand member of the Raritan formation in New Jersey. The rate of precipitation in the area studied by Barksdale is practically the same as that in the Baltimore area, and the general character of the sediments and conditions for recharge are similar; therefore it does not seem unreasonable to conclude that the potential rate of recharge to the Patuxent formation in the Baltimore area is approximately the same. On that basis, the potential average rate of recharge is about 1,000,000 gallons a day for each square mile of the outcrop area. It is difficult to determine the width of the outcrop that would be effective as an intake area; however a rough estimate of the average is 2 miles. This figure probably is too large for some parts of the outcrop area, but in places in the outcrop area the pre-Cambrian crystalline rocks are hydrologically connected to the Patuxent formation so that the effective width is larger than the width of the outcrop of the Patuxent formation alone. Assuming these figures to be correct, the potential rate of recharge to the Patuxent formation would average about 2,000,000 gallons a day for each mile of the outcrop measured along the strike.

According to the flow-net analysis of the piezometric contours (Pl. 7) the transmissibility of the Patuxent formation is about 20,000 in the Back River, Highlandtown, and Canton districts, near the outcrop, and averages about 50,000 farther down the dip in the Sparrows Point, Dundalk, Curtis Bay, and Fairfield districts. The maximum quantity of water that theoretically could be transmitted down the dip from the outcrop area would be determined chiefly by the lower transmissibility immediately down dip from the outcrop area and the maximum hydraulic gradient that could be established in that part of the formation. The maximum hydraulic gradient that theoretically could be developed throughout the area, without dewatering the artesian part of the formation and thereby decreasing the transmissibility, would be equal to the dip or slope of the top of the formation which is about 60 feet to the mile. If the average transmissibility of 20,000 determined for these industrial districts near the outcrop area is representative of the transmissibility in and near the outcrop of the Patuxent formation throughout the Baltimore area, then the theoretical maximum quantity of water that could flow down dip from each mile of the outcrop would be 20,000 x 60, or 1,200,000 gallons a day. This quantity is less than the estimated maximum recharge rate of 2,000,000 gallons a day in each mile of the outcrop; consequently it appears that the rate of recharge is not an important factor in limiting the quantity of water that can be withdrawn from the artesian part of the Patuxent formation. At present most of the large ground-water developments are in the artesian part of the formation. Even if the rate of recharge is very low during a dry year, as it may well be, the water withdrawn by wells can be derived from the very large quantity of water stored in the outcrop area; hence a dry period of one or even several years will have no significant effect on the quantity of water that can be pumped in the artesian part of the formation.

To develop the maximum flow of water from the outcrop in the Baltimore area by lowering the artesian head to the top of the Patuxent formation would require a very large number of wells spaced uniformly and pumped at low rates; such a costly method of development would not be at all practicable and it is not likely that the Patuxent formation, when considered in its entirety in the Baltimore area, will ever be developed to its maximum capacity.

At present, the pumping from the Patuxent formation in the Baltimore area is largely concentrated in the industrial area in and near Baltimore (fig. 8), and the pattern of pumping is controlled by factors that have controlled the location of industries. Many factors govern the location of industrial plants, but in this area the economic advantage of ready access to port facilities for seagoing vessels has been the chief cause of the dense industrial development around the Patapsco River estuary. Thus the location of most of the ground-water developments in the Baltimore area has been controlled indirectly by this economic factor.

As a large percentage of the pumping from the Patuxent formation in the Baltimore area is concentrated in the relatively small part of the area in and near Baltimore, if considered solely with respect to hydrologic principles, the development of water resources in the Patuxent formation has been largely inefficient. Furthermore, within the industrial area in and near Baltimore the pumping is concentrated in certain localities. The concentrated pumping has caused the artesian head or water table to be relatively low in and near the centers of pumping. Although a lowering of artesian head or water table is necessary to create a hydraulic gradient toward the wells, there is an ill-defined limit below which it is not economically feasible to lower the head. In the industrial area, where both water-table and artesian conditions exist in the Patuxent formation, this lower boundary cannot be determined accurately. The lower the water levels in wells the greater the cost of pumping; however, the cost of pumping apparently has not been a limiting factor in the industrial ground-water developments in the Baltimore area. Nevertheless, in the outcrop area a lowering of the water table in the aquifer causes a decrease in the saturated thickness of the aquifer which decreases the transmissibility. As the saturated part of the aquifer decreases in thickness the transmissibility will finally become so small that a further lowering of water level will not increase the yield appreciably. Although the exact position of this lower limit is not known accurately, it is likely that the position of the water table in and near the centers of pumping in the Back River and Highlandtown districts is so low that little additional water can be pumped from the major well fields in these districts. Plate 17 shows the position of the water table and artesian head in the Patuxent formation in the industrial area. According to this diagram the water table at the principal centers of pumping in the Highlandtown district is only about 30 to 50 feet above the bottom of the formation; it is about 50 feet above the bedrock in the center of pumping in the Back River district. In the areas between the centers of pumping in these districts the water table is as much as 130 feet above the base of the aquifer, showing the pronounced local effect of concentrated pumpage and showing that a more uniform distribution of pumping would permit a higher total rate of withdrawal in these districts.

Except near the outcrop area, in the artesian part of the aquifer in the industrial area the lower limit to which it would be hydrologically feasible to lower the artesian head is marked by the top of the Patuxent formation. If the artesian head is lowered below the top of the formation the aquifer will be partly dewatered and the transmissibility will decrease. Although the draining of water from the sediments would make available an additional increment of water, the gain would be only temporary for the water would be largely derived from storage. The dewatering of the aquifer in the artesian part of the area would indicate that more water is being withdrawn than is flowing toward the center of pumpage from the outcrop area. Thus the top of the Patuxent formation marks the lower limit to which it is hydrologically feasible to lower the artesian head in the Patuxent formation; however, in some parts of the area the cost of pumping water from that depth may be uneconomical. In the Sparrows Point district the top of the water-bearing material in the Patuxent formation may be as deep as 500 feet, and a pumping lift of this magnitude might be too costly for some uses. This factor, however, is variable, depending on the cost of other sources of water and on other economic factors.

The position of the artesian head with respect to the top of the Patuxent formation is shown in Plate 17. The only places where the artesian head has been lowered to near the top of the Patuxent formation are in the Curtis Bay and Fairfield districts in and near the centers of pumping; in the Curtis Bay district the artesian head, at the centers of pumping, is about 25 feet above the top of the formation. In the Dundalk district the artesian head is about 50 to 75 feet above the top of the aquifer at the centers of pumping, and in the Sparrows Point district it is about 300 feet above the top of the aquifer at the centers of pumping. Thus, disregarding economics, the only parts of the artesian aquifer in the Patuxent formation that appear to be developed to near the maximum are at the major well fields in the Curtis Bay and Fairfield districts. However, Plate 17 shows clearly that the practice of pumping from groups of closely spaced wells is hydrologically inefficient. For example, in the Curtis Bay district the artesian head is only about 25 feet above the top of the aquifer in and near the centers of pumping, but within a distance of half a mile to a mile from these centers the artesian head is as much as 150 feet above the top of the aquifer. Additional water could be pumped from the Patuxent formation if the wells were spaced at greater distances. However, the cost of installing the long pipe lines that would be required for widely spaced wells might be prohibitive in the industrial districts which contain many buildings, paved streets, and other cultural developments.

Plate 17 shows that the depth below the land surface to the top of the Patuxent formation increases to the southeast at the rate of about 60 feet to the mile and in the Sparrows Point district it is as much as 500 feet deep. Where the top of the formation is at a considerable depth below the land surface it is possible to pump at a higher rate without dewatering the aquifer than where the top of the aquifer is at a shallower depth. Thus the pumpage from the Patuxent formation in the Sparrows Point district could be more than doubled without causing dewatering of the aquifer in that district, but this increased pumpage would cause an additional decline in head or decrease in yield of other wells in the Patuxent formation in the area.

The pumping of water from the Patuxent formation in the industrial area has lowered the water table below the level of the Patapsco River estuary in the Harbor district and consequently the formation is being contaminated with salt water through local encroachment. As a result, some industries have been forced to obtain water from the Baltimore public supply, and others have found that the contaminated water can be used only for certain cooling operations. Though in this respect pumping from the Patuxent formation in the industrial area has exceeded the safe yield, certain factors should be considered before it is deemed advisable to decrease the pumping sufficiently to stop the encroachment of salt water. The salt-water encroachment largely originates in the Harbor district and, although pumpage from all the districts in the industrial area has contributed to the decline in the artesian head and water table in the Harbor district, the heavy pumping in that district and previously in the Canton district, has been the major cause of the decline in head and resulting salt-water encroachment. If pumping in the Harbor district were stopped it would permit the salt water already in the formation to move more readily to the centers of pumping in the other industrial districts. The salt-water contamination could be largely stopped by constructing artificial-recharge wells at certain localities and building up the head above the level of the Patapsco River estuary in the localities where there is encroachment. It would be necessary also to construct wells some distance down dip from the recharge wells to divert the contaminated water already in the formation. Before such a proposal could be determined to be practicable, it would be necessary to have more detailed geologic and hydrologic data than are now available. Under present conditions or until remedial measures are devised, the pumping in the Harbor district should not be reduced even though it is inducing salt-water encroachment from the Patapsco River estuary.

In summation, the only part of the Baltimore area in which the Patuxent formation is heavily developed is in the industrial districts in and near Baltimore. There is no single maximum quantity of water that can be pumped from the Patuxent formation in the industrial area, because economic factors, chiefly cost of development, are the major limitations on the quantity of water that can be pumped. In the industrial area as a whole the pumpage could be increased appreciably by spacing the wells more uniformly throughout the area. However, it would not be desirable to increase pumping near the major centers of withdrawal in the Fairfield, Curtis Bay, Highlandtown, and Back River districts. The desirability or feasibility of pumping additional quantities of water from the Patuxent formation in other parts of the industrial area is largely a matter of economics. An increase in pumping from the Patuxent formation from existing well fields or new developments will either lower the head or decrease the yield of other wells in the Patuxent formation in the area. Although the theoretical effect of pumpage can be evaluated the economic impact on any industry or other well owner is a factor that cannot be measured by hydrologic formulas.

PATAPSCO FORMATION

The water pumped from the Patapsco formation, like that from the Patuxent formation, is derived from recharge in the outcrop area. Conditions for recharge to the Patapsco formation are excellent and the potential rate of recharge is as high, if not higher, than that of the Patuxent formation. The outcrop of the Patapsco formation generally is sandy and the land surface is gently rolling. These factors, in addition to the relatively large size of the area of outcrop, indicate that the potential recharge may be very large and is not a significant factor in limiting the safe yield of the formation.

The transmissibility of the formation and the hydraulic gradient produced by pumping are the chief limiting factors in determining the quantity of water that can be transmitted from the outcrop to the artesian part of the formation. The transmissibility of the aquifers in the formation probably is extremely variable, but in general the transmissibility probably is less than that of the Patuxent formation.

The Patapsco formation is incised by estuaries tributary to Chesapeake Bay, so that the aquifers are susceptible to contamination by salt water. In the industrial area heavy pumping from the Patapsco formation has caused local encroachment of salt water, chiefly from the Patapsco River estuary, and, although pumping has been reduced greatly since 1942, the artesian head or water table is still below the level of the estuary in a large part of the industrial area. Thus the safe yield of the Patapsco formation has been exceeded; however, as for the Patuxent formation, it is necessary to consider several factors before concluding that it would be desirable to decrease or stop the present pumping, which is chiefly in the Sparrows Point district, in order to prevent salt water from entering the formation. Even if pumping were stopped completely so that the artesian head or water table would rise above the level of the estuary, it would take a long time, perhaps many decades, for the contaminated water to be flushed out of the aquifers in the Patapsco formation in the industrial area. Moreover, the increase in artesian head in the formation would increase the flow of contaminating water to the Patuxent formation through leaking wells. With the present rate and distribution of pumping from the Patapsco formation, the area of contamination probably will not increase much beyond its present size. It is fortunate that the only remaining major pumping from the Patapsco formation is in the Sparrows Point district, which is farther down the dip of the formation than any of the other industrial districts, so that the contaminating water is diluted considerably by inflow of fresh water; moreover, according to the piezometric contours in Plate 14, the pumping in the Sparrows Point district causes fresh water to move from the southwest toward the Curtis Bay and Fairfield districts. It is possible therefore that in time the degree of contamination in the Curtis Bay and Fairfield districts may decrease.

In the Sparrows Point district one is faced with the difficult question of whether it is more desirable to utilize the water with its accompanying economic benefits but also with continued encroachment of salt water into the formation, or whether it is more desirable to reduce the pumping greatly or stop it entirely with the expectation that the contaminating water would be flushed out of the area after a period of many decades. In any event, it would not be desirable to reduce or stop the present pumping until the wells that leak salt water to the Patuxent formation have been repaired or plugged.

As the existing pattern of ground-water flow in the Patapsco formation is such that eventually the contamination in the Curtis Bay and Fairfield districts may decrease, it would not be desirable to pump large quantities of water from the formation in those districts, or immediately southwest of them, as the direction of flow might be reversed, thereby increasing the degree of contamination. This might seem incongruous with the possible desirability of continuing the present pumping in the Sparrows Point district; however, the Curtis Bay and Fairfield districts, and also the Dundalk district, are farther up dip, and it is likely that pumping from the Patapsco formation in these districts eventually would cause a much greater degree of contamination than that due to pumping in the Sparrows Point district.

PLEISTOCENE DEPOSITS

In this area the upland unit of the Pleistocene deposits is so limited in areal extent and so little utilized for water that the factors concerning safe yield cannot be evaluated. The lowland unit of the Pleistocene deposits occupies a large part of the northern half of the Baltimore area, but the sediments are so irregular in thickness and in content of water-bearing material that it is not possible to consider them as forming a single extensive ground-water reservoir. For this reason it generally is necessary to consider each small locality or ground-water development when evaluating the factors affecting the safe yield.

At present pumping from the lower unit of the Pleistocene deposits in the industrial area is relatively small, so that the question of safe yield is not important. Many years ago, some water was pumped from the unit in the Sparrows Point district but because of encroachment of salt water pumping was stopped. In those parts of the area that are near salt water in the estuaries or Chesapeake Bay, the Pleistocene deposits are very susceptible to contamination by salt water which is the limiting factor of the safe yield. In the parts of the area some distance from salt water, however, the safe yield probably is limited chiefly by the transmissibility. In one locality in the industrial area, near St. Denis, the safe yield of the Pleistocene deposits is increased as a result of induced infiltration of water from the Patapsco River, which at this locality is fresh. The well (Bal-Gc 1) is of the collector type and is close to the river. Records of the temperature of the water from the well and from the river indicate that a large part of the water pumped is derived from the river.

ARTIFICIAL RECHARGE

One method by which the safe yield of an aquifer may be increased is by causing recharge artificially. Artificial recharge is being practiced in several places in the United States and Europe (Meinzer, 1946; Sayre and Stringfield,

1948) but has not been practiced in the Baltimore area, although the possibility of its use has been considered by at least two industries.

Artificial recharge may be employed directly by either of two methods, (1) recharge by applying water at the land surface, or in ponds or basins, and (2) recharge through wells. An aquifer can be recharged by surface application only where the aquifer is exposed so that the water may move readily downward to the zone of saturation. In the unconsolidated sediments in the Baltimore area the aquifers are directly exposed in the outcrop areas. However, as the potential rate of natural recharge on their outcrops does not limit the quantity of water that can be pumped in the area, artificial recharge by water spreading would not increase the safe yield of the aquifers.

Artificial recharge by introducing water through wells in or near the centers of pumping would, however, increase the quantity of water available for use, but in addition to economic factors several hydrologic factors should be considered before such a practice is started.

One of the major uses of water in the industrial area is in cooling. Some industries that use water from the Baltimore public supply in addition to ground water find that the public-supply water generally is too warm during the summer for some cooling operations. Consequently, there is an increased demand for the cool ground water during the summer. In those localities where ground water has been developed extensively it may be difficult to obtain the additional ground water without drilling wells at a relatively long distance from the present well fields. Where such conditions occur it might seem advantageous to attempt to store water from the public supply in the aquifer during the winter, when the water is cold, for use during the summer. However, approximately the same advantage would be gained by reducing pumping of ground water during the winter and making up the difference through the direct use of public-supply water, thereby avoiding the substantial cost of introducing water into the aquifer and later pumping it out. The decrease in pumping from wells during the winter would cause the artesian head or water table to rise so that more ground water could be pumped during the summer when the public-supply water is warm. It should be emphasized that, until all wells that leak highly mineralized water in or near a well field are repaired or plugged, the pumping from wells should not be stopped completely, for the leakage of highly mineralized water would continue during the period of no pumping and would increase the mineral content of the water in the aquifer.

It is possible that the temperature of water in cooling operations for some industrial processes is so critical that it may be economically feasible to store public-supply water in the ground during the winter, when it is colder than ground water, for use during the summer. If this is done, it generally would not be advisable to recharge the Patapsco formation where it contains highly mineralized water, as the resulting increase in head would cause an increase in contamination of the Patuxent formation through leaking wells. If it is desired to recharge the aquifers artificially with cold water for use several months later, it probably would be advisable to construct the recharge wells at a distance of at least several hundred feet from any wells from which ground water is pumped during the winter, in order to avoid pumping the cold water out before summer comes.

One of the requisites of a good location for a recharge well is to put it where the static water level is low, thereby permitting a large build-up of the hydrostatic head. Artificial recharge through wells may involve several difficulties. The screen, or the aquifer immediately outside the screen, may become partly clogged with fine sediment (Brashears, 1946, p. 510), mineral compounds, and bacteria and algae, reducing the input capacity of the well. Recharge wells may, therefore, occasionally require cleaning.

As artificial recharge through wells in the industrial area involves many economic and hydrologic factors, no conclusion can be reached as to its feasibility that would apply with equal force to all parts of the area. It would be prudent, however, for industries, particularly those requiring cold water for cooling, to consider carefully the possibility of utilizing artificial recharge to increase their supply of cold water for use during the summer.

THEORETICAL EFFECT OF PUMPING ON ARTESIAN HEAD

Before the development of large ground-water supplies in the Baltimore area, the principal aquifers were in a state of dynamic equilibrium. The water that entered the aquifers, chiefly in the outcrop areas, was discharged naturally by movement through the confining beds in the artesian parts of the aquifers. The withdrawal of water by wells is an additional discharge from the previously balanced hydraulic system. Thus with the additional discharge from the system through wells, either the aquifer must receive more recharge or the natural discharge must be reduced by an amount equal to the pumpage, before the system will be stabilized and again be in dynamic equilibrium.

Under natural conditions the quantity of water flowing through a unit cross-sectional area of the aquifers in the Patuxent and Patapsco formations was relatively small and therefore the natural discharge per unit area was correspondingly small. Owing to the small rate of natural discharge from the artesian part of these aquifers, the major component in restoring these hydraulic systems to dynamic equilibrium after pumping began was necessarily an increase in the rate of recharge. The natural discharge cannot be decreased, nor the recharge increased, unless the hydraulic gradient is changed in the areas of discharge and recharge.

When a well ending in an artesian aquifer is pumped, the artesian head around the well declines to form a cone of depression, with the apex or deepest part of the cone at the pumped well. Before the cone of depression can become stable it must deepen and expand until it causes a reduction in the natural discharge or increase in the recharge equal to the quantity of water pumped from the well. In the Patuxent and Patapsco formations in the Baltimore area the unit rate of natural discharge is small so that the cone of depression will expand until it reaches the recharge area. By thus increasing the hydraulic gradient, the flow of water from the recharge area will increase by an amount approximately equal to the pumpage. In the Baltimore area this additional increment of water probably is gained chiefly by a reduction of ground water flowing into streams crossing the outcrop of the aquifer.

The water pumped from an artesian aquifer during the period in which the cone of depression is expanding and deepening is derived from storage within the artesian aquifer. Although the sediments are not drained of water as they are when the water table declines in an unconfined aquifer, the artesian aquifer and the water it contains are slightly elastic; when the head is lowered, a little water is squeezed out of storage by compaction of the fine sediments, and the water itself expands slightly. The released water, the amount of which is determined by the coefficient of storage, and the coefficient of transmissibility are the controlling hydrologic factors that determine the rate of growth of a cone of depression, and accordingly the amount and rate of decline in artesian head caused by pumping.

The theoretical decline in hydrostatic head at any distance and within any length of time after pumping is started can be computed by the Theis nonequilibrium formula. Even though aquifers do not conform completely to the assumptions on which this formula is based, it has been demonstrated that in aquifers that are reasonably uniform the formula may be used to determine fairly accurately the changes in hydrostatic head accompanying changes in pumping (Guyton, 1942, pp. 40-48).

As the aquifers in the unconsolidated sediments in the Baltimore area are extremely variable and have a wide range in transmissibility, conditions are not favorable for using the Theis nonequilibrium formula to predict changes in head over a large area or during long periods of time; nevertheless, the formula serves as a means of evaluating hydrologic conditions.

By using the coefficients of storage and transmissibility within the range determined by the most reliable pumping tests and the flow-net analysis, application of the Theis formula indicates that there has been ample time for the major cone of depression formed in the Patuxent formation to reach the outcrop of the aquifer and to induce additional recharge. As the present rate of recharge still is less than the potential rate, the hydraulic system is in equilibrium. If pumping from the formation is continued at the same rate and at the same localities, the water levels in wells ending in the Patuxent formation will not decline appreciably in the future. This conclusion is supported somewhat by the records of water-level fluctuations in observation wells; however, the records are so short and the fluctuations so pronounced, owing to intermittent changes in the rates of pumping, that it is difficult to determine the trend of the water levels accurately.

The mathematical theory of ground-water hydraulics and the observed water-level fluctuations show clearly that pumping from aquifers such as the Patuxent and Patapsco formations has a widespread effect on the hydrostatic head; consequently pumping from one well eventually will affect most or all of the other wells ending in the same aquifer. Thus, if an additional quantity of water is pumped from an existing or a newly developed well field, there will be some decline in head or reduction of yield at all or nearly all other wells ending in the same aquifer. If the distance from the new center of pumping to the affected wells is great, the amount of decrease in head or yield may be inappreciable, but in the Baltimore industrial area most of the well fields are sufficiently close to each other that appreciable interference results from new withdrawals.

The Theis formula generally is useful in evaluating the magnitude of this interference; however the hydrologic characteristics of the major aquifers in the Baltimore area are so irregular that the formula can be used only over relatively small areas to predict approximate decreases in head due to pumping. When a well is pumped the head does not decline at a uniform rate; for example, Figure 29 shows the theoretical increase in drawdown in an infinite aquifer having certain characteristics during a period of 1,000 days after pumping starts. Assuming the coefficients of transmissibility and storage to be, respectively, 50,000 gallons a day per foot, and 0.00026, at a distance of 1 foot from the pumped well, the theoretical drawdown at the end of 1 day after pumping starts is 72 percent of the total drawdown at the end of 1,000 days of pumping; the drawdown at the end of 100 days is 91 percent of the total. The assumed coefficients used in constructing the graph in Figure 29 are within the range of coefficients determined for the Patuxent formation in the Baltimore industrial area. They show clearly that a large part of the total drawdown in a pumped well ending in the Patuxent formation in the industrial area occurs within a few days after pumping starts. The drawdown at greater distances from the pumped well, however, will occur less quickly. A considerable period of time may pass before the water level in a distant well is affected at all.

The coefficient of transmissibility of the Patuxent formation was determined by flow-net analysis to range from 16,500 gallons a day per foot in the Back River district to 70,000 in the Dundalk-Canton district (Table 9) and the coefficient of storage in the artesian part of the aquifer was determined by pumping tests in the Sparrows Point district to be 0.00026. Using

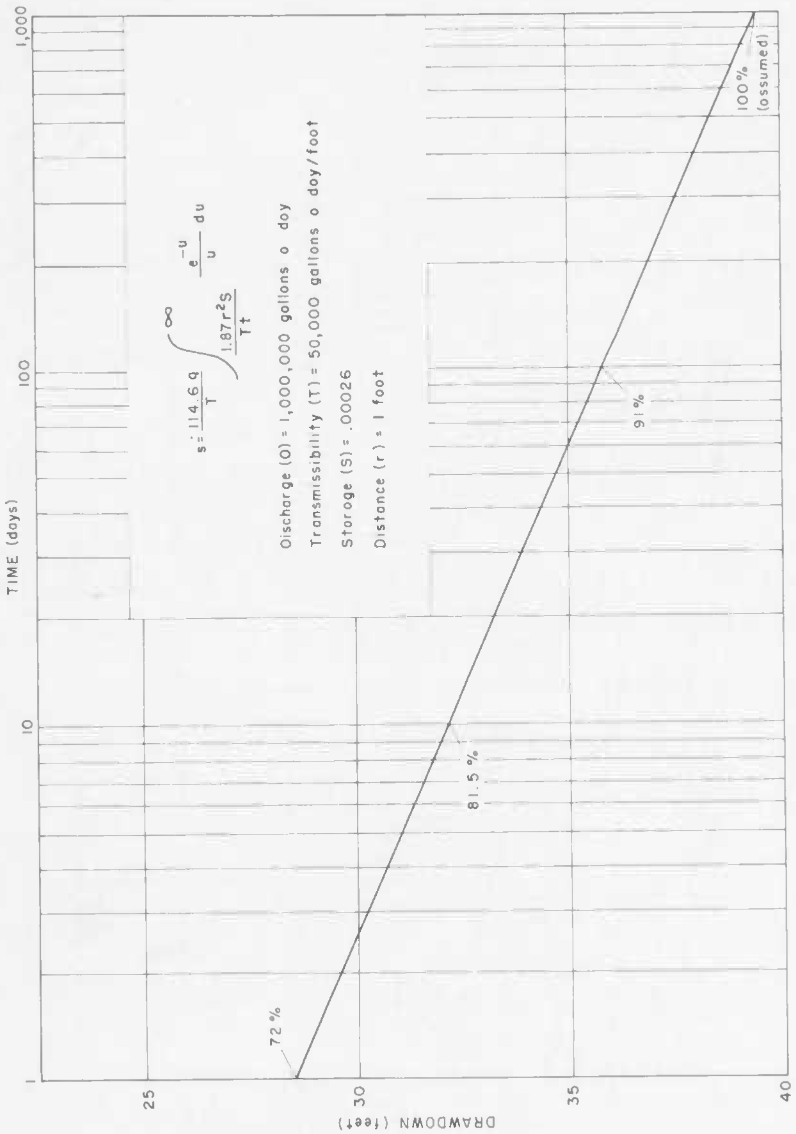


FIGURE 29. Graph showing the theoretical increase in drawdown in an infinite aquifer with increase in time

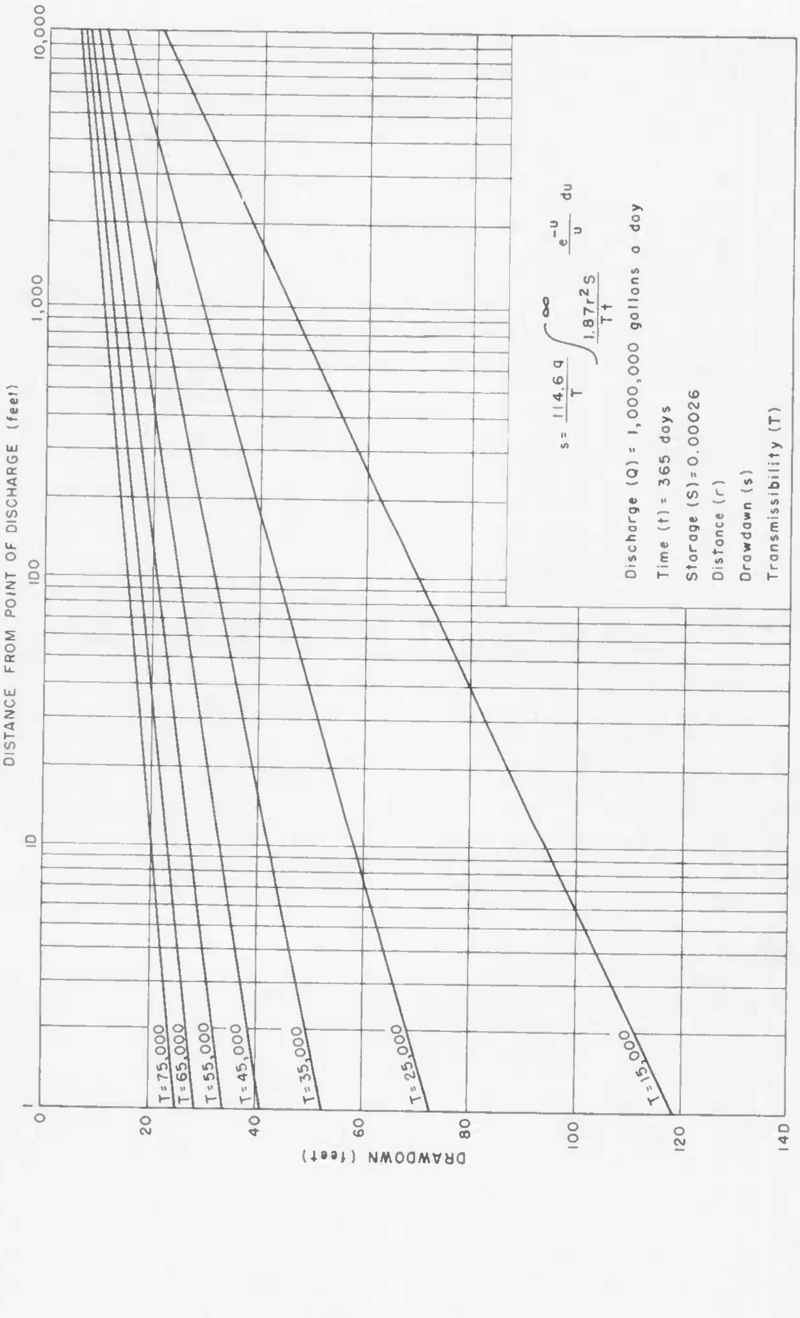


FIGURE 30. Graph showing the theoretical drawdown in an infinite aquifer for different coefficients of transmissibility

this coefficient of storage and using coefficients of transmissibility ranging from 15,000 to 75,000, a series of curves was constructed (fig. 30) showing the theoretical drawdown at distances of 1 to 10,000 feet after pumping at the rate of 1,000,000 gallons a day for 1 year. The graph serves only as a guide in evaluating the general order of magnitude of decline in water levels that would occur with an increase in pumping. The theoretical drawdown is directly proportional to the pumpage. If the pumping rate is 500,000 gallons a day the drawdown would be half that shown in Figure 29. The drawdown given for a distance of 1 foot from the pumped well should not be considered to represent the drawdown in the pumped well, for the efficiency of the well—the loss in head in the screen, etc.—has considerable effect on the total drawdown in the pumped well.

The theoretical drawdowns shown in Figure 30 are computed on the assumption that the aquifer is infinite. Obviously the Patuxent formation is not infinite; indeed, one boundary, marked by the outcrop of the formation, is within a relatively short distance from the pumped wells. Where conditions are ideal the effect of boundaries in an aquifer can be computed mathematically (Muskat, 1937, pp. 186-192; Theis, 1941); however, the coefficient of transmissibility of the Patuxent formation has such a wide range that, in effect, there are many boundaries, and to correct the drawdowns only with respect to the boundary marked by the outcrop would be meaningless. It is likely that the most accurate method of determining the theoretical drawdowns in the Baltimore area, taking into consideration the variation in transmissibility and the boundary conditions, would be through the use of elaborate electrical models as has been done in determining the theoretical decline in pressure of oil reservoirs (Bruce, 1942, 1943).

WELL-CONSTRUCTION METHODS

The development of large ground-water supplies has been made possible chiefly through the development of efficient well pumps and the improved methods of drilling and constructing wells. Few wells were drilled in the Coastal Plain part of the Baltimore area until J. N. Bolles, using a drilling technique invented by him, began drilling wells about 1853 (Tyson, 1860). The drilling equipment generally used consisted of a boring tool shaped like a large corkscrew that was inserted inside a pipe or casing. The screw was turned either by hand or by steam power, and the pipe or casing was forced down with heavy levers.

Later the cable-tool percussion method and still later the rotary method came into general use for drilling industrial wells. In the cable-tool method a series of blows is struck against the bottom of the hole with a heavy tool or bit with a cutting edge. The bit assembly, which is attached to a rope or steel cable, is raised and then dropped by the action of a rocker arm on the drilling rig. After the material at the bottom of the hole is loosened it is removed in a long, narrow bucket with a flap valve in the bottom called a bailer. In the unconsolidated sediments it usually is necessary to install casing as the hole is deepened in order to prevent the sediments from caving. In the area underlain by crystalline rocks, casing is generally needed only through the weathered zone near the surface.

The drilling of deep industrial wells by the cable-tool method in unconsolidated sediments frequently met with difficulties, and, in comparison with the rotary method now generally used, required a long time for completing a well. Moreover, it frequently became difficult to drive casing beyond a certain depth, and to go deeper it was necessary to reduce the size of the bit and drive a smaller casing inside the larger casing. In the Baltimore area some old industrial wells drilled by the cable-tool method have as many as four strings of casing.

By about 1930 the principal drillers of industrial wells in the Baltimore area had abandoned the cable-tool percussion method in favor of the hydraulic-rotary method. The hydraulic-rotary method of drilling consists of rotating a cutting tool or bit attached to the bottom of a string of hollow drill rods. The drill-rod and bit assembly is rotated by machinery at the floor of the drilling rig and a viscous mud fluid is pumped downward through the drill rod and is ejected through holes in the bit. The rotation of the bit on the bottom of the hole loosens the sediments, and the mud fluid, which returns to the surface through the space between the drill rod and the wall of the well, carries the sediments out of the hole. On the surface the mud fluid is conducted to a settling basin or mud pit, where the sediments settle out; then the mud fluid is recirculated through the drill rods in the well. The circulation of the mud fluid builds up a relatively impervious covering on the wall of the well, and the column of dense mud fluid exerts a pressure against the sediments, preventing them from caving. Thus by the rotary method a hole may be drilled without inserting casing.

The rig used to suspend the drill-rod assembly in the hole varies somewhat in accordance with the depth and diameter of the well to be drilled. Small-diameter wells may be drilled with a truck-mounted rig having a mast that may be telescoped and folded down for easy transport. Large-diameter industrial wells in the Baltimore area, however, require the use of much heavier rigs. One of the principal well drillers in the Baltimore area assembles a wood derrick at each well site (Pl. 25 A).

Several types of cutting tools or bits are used in rotary drilling but the type used most commonly in the Baltimore area is the rock bit (Pl. 26 A). This bit, which consists essentially of three cone-shaped rollers containing several rows of cutting teeth, penetrates sand and gravel very quickly and is particularly useful in cutting through the thin layers of indurated rock in the sediments in the Baltimore area.

The principal advantages of the rotary-drilling method for industrial wells penetrating unconsolidated sediments are the speed and ease of drilling large-diameter wells, and the practicability of readily developing more than one water-bearing zone in a single well. The rotary-drilling method generally is not a practical method for drilling wells in the hard crystalline rocks; in that part of the area wells are drilled almost exclusively by the cable-tool method.

Domestic and farm wells in the unconsolidated sediments are generally drilled either by the cable-tool method or by the jetting method. In the jetting method water is forced under pressure down a 1- to 2-inch diameter pipe, which may have a small chisel-type cutting tool on the end. The hole is drilled by raising and lowering the pipe, which loosens the sediment at the bottom of the hole, and the cuttings are returned to the surface by the water that flows out the bit, then upward outside the drill pipe. The method thus combines some of the features of the cable-tool and rotary methods. In loose, unconsolidated sediments the action of the water jetting from the bit deepens the hole more than the pounding action of the bit. The jetting method is well adapted to the drilling of wells for domestic use because it is quick and relatively cheap. It is not a satisfactory method, however, for use in large-diameter industrial wells or for drilling hard rocks.

Many industrial wells in the Baltimore area, constructed by the cable-tool method 25 to 30 years ago, are still in use. Most of these wells were started with 8- or 10-inch casings, but in some the surface casing is 12 inches in diameter. In many of these wells the casing was reduced in size several times during drilling, and in some the screen diameter is only 4½ inches although the surface casing is 12 inches. In some of these wells the screen consists of punched or slotted pipe of low efficiency in admitting water; this, together with the relatively small diameter of the pipe, makes the wells less productive than wells having the large-diameter commercial screens installed in recent years. Most of the older cable-tool wells are equipped with air-lift pumps (Pl. 25 B) which have a wide range in performance, depending on depth of submergence of the eductor pipe, volume of air, and other factors.

The industrial wells drilled by the rotary method were constructed in several ways. In general, the practice has been to drill first a small-diameter test or "pilot" hole so that the depth and thickness of the permeable water-bearing zones can be determined. The hole is then reamed to a large diameter extending to near the top of the aquifer; casing is inserted in the hole, extending to near the top of the screen, and the annular space between the casing and the wall of the well is cemented to protect the casing from corrosion. Before the casing is cemented, the part of the hole in the aquifer is backfilled with sand to the top of the aquifer to prevent the cement from entering the permeable water-bearing zone. Finally the aquifer is drilled out and screens are lowered through the casing and set opposite each of the permeable sand and gravel beds. The screen assembly and the well casing overlap; the small annular space between them generally is closed with a lead seal or ring attached to the top of the screen assembly. The lead seal is swedged out tightly against the well casing.

Many of the rotary-drilled industrial wells are artificially gravel-packed to increase the effective diameter of the well and to prevent fine sand from entering the well. The gravel packing has been done by several different methods. One method, not in common use at present, is to drill from two to four gravel-conducting wells, 4 to 6 inches in diameter, a few feet from the large-diameter production well. The gravel-conducting wells are drilled to the top of the aquifer and, as the production well is surged and pumped to remove the finer water-bearing material, gravel is fed down the adjacent conducting wells. This method of gravel packing is very effective but has the disadvantage of requiring the construction of auxiliary wells. Moreover, the auxiliary wells increase the possibility of leaking of salt water in those parts of the area where the shallow aquifers contain salt water. Another method of gravel packing is to enlarge the hole in the permeable water-bearing zone by underreaming and then pumping the gravel in under pressure. The method used now by one of the principal well-drilling companies consists of installing a casing and screen inside the outer casing of the well. As the well is pumped and surged to form a cavity around the screen, gravel is washed through a small-diameter pipe into the cavity around the screen. Ordinarily the annular space between the two casings also is partly filled with gravel to serve as a reserve supply.

Practically all the industrial wells completed within the last 15 to 20 years are equipped with deep-well turbine pumps powered by electricity (Pl. 26 B).

Although well-construction methods have been improved greatly in recent years, it is not uncommon for wells to develop defects. One of the most troublesome problems, particularly in the Baltimore industrial area, is corrosion of screens which reduces their strength and causes them to collapse or increases the size of the screen openings and allows sand or gravel to enter the well (Pl. 24 B). Although corrosion-resistant screens, generally of bronze, brass, or Everdur, are used in industrial wells, in some localities in the industrial area the screens last for only a few years. Monel-metal and stainless-steel screens have recently been installed in a few wells, but there has not been sufficient time to determine whether these screens will last longer. Causes of screen corrosion in this area are galvanic action between dissimilar metals in the well, chemical action due to acidity or high salinity of water, and probably stray electrical currents from nearby industrial operations.

Another cause of difficulty in well operation is the passing of fine sand through the screen when the well is being pumped. Through years of pumping a well may discharge a large quantity of sand even though the water appears to be clear and free of sand. Eventually cavities may be formed near the well, and the land surface immediately adjacent to the wells may subside, as has happened at some wells in the Baltimore area. As the sand and gravel aquifers in the Baltimore area are highly irregular and the sediments generally are not well sorted, it generally is not possible to select a single screen-slot size that is suitable for all parts of the aquifer. One approach to the problem lies in the fact that the movement of sand through the sediments immediately adjacent to the well and screen is controlled by the velocity of the water. Other things being equal, the velocity of the water just outside the screen is controlled largely by the diameter of the screen. If the screen diameter is large the entrance velocity of the water will be less than through a small-diameter screen, and accordingly the ability of the water to carry sand would be less. It is costly and perhaps impractical to install extra-large screens merely to prevent or decrease passage of sand. Instead the effective diameter of the screen may be increased by gravel packing. A gravel pack consisting of coarse sand or gravel of the proper size for a particular aquifer may reduce materially the velocity of water adjacent to the screen and thereby decrease the quantity of sand entering the well. Moreover, if some sand is pumped regardless of the gravel pack, the space formed by the removal of the sand will be filled from the reserve supply of gravel between the casings in the well, if that method of gravel packing is used.

In some parts of the area the aquifers are composed largely of coarse sediments and gravel packing may not be needed. In such aquifers the gravel pack that may be formed naturally by surging and pumping the well at maximum capacity may be more effective than an artificial gravel pack. During the development of the well the fine material outside the screen is drawn into the well and the coarse material collects against the screen, thus forming a gravel pack in which the water-bearing material is graded, being finer away from the well. After a well is developed in this manner it should not be pumped at a rate greater than about two-thirds of its maximum capacity (Sayre and Livingston, 1945, p. 96).

Probably the most serious problem, with respect to defective wells, is the development of openings in or outside the casings of the wells through which highly mineralized water may pass and contaminate the fresh-water aquifers. In most such wells it is more economical to repair the leaks than to drill a new one to replace it. The repair of the leaks, however, may be difficult and requires very careful and detailed planning, in addition to a good knowledge of the technique and principles of well cementing. The method that may be used in repairing a well depends largely on the type of opening, its location in the well, and on the construction of the well. If the well has a sufficiently large diameter it may be repaired by inserting a new casing inside the old. As this reduces the diameter of the well, in some wells it might be necessary to install a smaller-capacity pump.

A leak may be stopped by rotating, with rotary-drilling equipment, a new casing around the outside of the defective casing, extending it to some depth below the leak. This method, however, is difficult and costly, and so far as is known has never been used in the Baltimore area.

Generally the most practical method of repairing a defective casing, or stopping movement of water along the outside of the casing, is by squeeze cementing. Squeeze cementing consists of pumping a cement slurry (neat cement and water) through an opening or openings in the casing against the formation containing highly mineralized water. Squeeze cementing has been used extensively in oil fields, and there are commercial companies specializing in cementing oil wells.

In recent years squeeze cementing has been used to stop leaks in some wells in the Baltimore area. Several wells at the Bethlehem Steel Co. plant in the Sparrows Point district were successfully repaired by squeeze cementing, thereby avoiding the greater expense of plugging them and drilling new wells.

It is not possible to set forth any rigid procedure for squeeze cementing of water wells in this area, as conditions differ from well to well. It is always essential, however, to determine accurately the manner in which the highly mineralized water is entering the well and the exact location of the openings, and to plan carefully the entire cementing procedure so that it may be carried to its completion without interruption. If the location of the salt-water sand can be determined from well logs and other data it may be desirable to make a few perforations in the casing opposite it so that the salt-water sand can be readily cemented. It usually is necessary to fill the well with fine sand to near the level of the openings in the casing; the sand prevents the cement from moving down the well and plugging the aquifer. The cement slurry should be pumped down the well, to the level of the openings, through a pipe, generally about 2 inches in diameter; and the casing should be so capped at the top that the pumping of cement into the well will build up a sufficient pressure to force the cement through the openings in the casing and along the outside of the casing opposite the salt-water sand.

Except under unusual conditions the cement should be pumped continuously until the job is completed. The selection of the proper water-cement ratio in squeeze cementing of water wells is not simple, for it depends on such factors as the permeability of the sand and gravel penetrated by the well, the width and the total volume of the annular space between the wall of the bore hole and the casing, the rate at which the cement slurry will be pumped into the well, and the pressure under which the slurry will be applied. According to Machis (1946, p. 1227), who made a detailed laboratory investigation of the principles of water-well cementing, especially as related to the Baltimore area: "Under no circumstances is there any justification for using a blanket rule for the selection of the slurry concentration, as has been attempted by many writers. In some cases the slurry may be very dilute, the excess water serving only as an agent to carry the cement into position, after which it is squeezed out and the cement particles are compacted. The initial slurry concentration will have no bearing on the volume, strength, or permeability of the final product. In other cases, it may be desirable to grout off a given formation without allowing the slurry to spread over other strata. In these circumstances, it would be desirable to use a thick slurry and a high squeeze pressure."

So far as is known, portland cement has been used in all the squeeze-cementing jobs on wells in the Baltimore area. Although it appears to be satisfactory, it would be desirable to try some of the cements that are specially made by commercial firms to meet certain requirements in the cementing of wells. Although these cements were developed chiefly for use in oil-well cementing, they should prove equally satisfactory for cementing water wells.

The chief objective in plugging abandoned wells is to prevent highly mineralized or polluted water from contaminating fresh-water aquifers. Like the squeeze cementing of wells, the plugging of abandoned wells should be done carefully and thoroughly and the method used should be selected only after consideration of the construction of the well and the geologic and hydrologic conditions. This is particularly so in the Baltimore industrial area, where salt and acid water may contaminate aquifers through abandoned wells that are not sealed effectively.

One of the most important features of plugging a well is the preparation of the well so that the cementing material may readily fill all openings. All inner casings in a well, if it is multiple-cased, should be removed and the outer casing perforated so that the openings outside the casing may be filled. Because the casing was not perforated, some wells in the Baltimore area thought to have been effectively plugged may be leaking highly mineralized water to fresh-water aquifers.

Ordinarily it is desirable to fill the well with fine sand to the top of the screen in order to avoid excessive loss of cement slurry into the aquifer; moreover, cementing of the fresh-water aquifer serves no useful purpose. The cement slurry should be pumped to the bottom of the well through a conductor pipe, at least 2 inches in diameter, and the top of the casing should be capped in such a manner that the cement can be pumped under pressure. As the cement fills the hole the conductor pipe should be raised and the water in the well should be discharged from a valved opening attached to the casing cap.

Well Bal-Gf 25 (Sparrows Point district), owned by the Bethlehem Steel Co., was effectively plugged in this manner in 1943. This well was 330 feet deep, with a 16-inch casing to a depth of 69 feet, a 12-inch casing from the surface to 172 feet, a 10-inch casing from the surface to 288 feet, and a 6-inch casing from the surface to 280 feet. A $4\frac{1}{2}$- and 6-inch screen of punched brass pipe was set from 305 to 330 feet and a $4\frac{1}{2}$-inch blank brass pipe from 268 to 305 feet, thus extending 12 feet up into the 6-inch casing. The well was leaking salt water originating in a sand above a depth of 200 feet. The 6-inch casing was removed and the 10-inch casing was cut off at about 170 feet and the part above that depth removed. The 12-inch casing was then perforated from the surface to a depth of 170 feet. A 2-inch pipe for conducting the cement was lowered in the well to a depth of 285 feet and a cap was put on the 12- and 16-inch casings, with a valved opening tapping the annular space between them. A cement slurry of 10 gallons of water to 1 sack of cement was pumped into the well through the 2-inch pipe. Although a cement slurry of 10 gallons of water to 1 sack of cement is rather thin and fluid, it was selected to facilitate passage through small openings.

At frequent intervals during the time the cement was being pumped into the well, the valve between the 12- and 16-inch casings was opened to discharge the water from the well. When a thick cement slurry began to issue from the valve, the valve was closed and the pumping continued until the pressure built up to 200 pounds per square inch, the maximum that could be generated by the pump.

Although there was no way in which the effectiveness of this cementing job could be measured, it is likely that all leakage of contaminating water was plugged off and that the well can be considered satisfactorily plugged.

Unfortunately, however, not all plugging of wells in the Baltimore industrial area has been done in this manner. Some have been filled with cement or clay by shoveling or pouring the material in the well; such wells may still be leaking highly mineralized water down the outside of the casing.

Although rather elaborate cementing procedures are needed within the industrial area, where contamination of highly mineralized water is possible, it is not necessary to use such methods in other parts of the area. Where contamination by highly mineralized water is not possible it probably is generally satisfactory to plug a well without perforating the casing. It is likely that heavy mud fluid would plug these wells about as satisfactorily as would cement; however, the top of the casing should be capped or covered over by a cement curb.

SUMMARY AND CONCLUSIONS

Most of the large ground-water developments in the Baltimore area are concentrated in the industrial districts in and near Baltimore. The principal aquifers are the Patuxent formation of Lower Cretaceous age and the Patapsco formation of Upper Cretaceous age, which are separated by the Arundel clay of Upper Cretaceous age. In a part of the industrial area the water-bearing material in the Patapsco formation is separated into an upper and lower aquifer by a fairly extensive clay bed. Some ground water is obtained from fractures in the pre-Cambrian crystalline rocks that underlie the Cretaceous sediments and crop out northwest of the Fall Line, and from the sand and gravel in the Pleistocene deposits that occur at relatively shallow depth in some parts of the area. The Patuxent and Patapsco formations, which consist chiefly of irregular beds of sand, gravel, and clay, dip gently southeastward toward the Atlantic Ocean, and the sediments thicken progressively toward the southeast. The Patuxent and Patapsco formations crop out as bands of irregular width extending northeast.

The yields of large-diameter wells ending in the Patuxent formation have a wide range but in the industrial area generally are about 400 to 600 gallons a minute. Industrial wells in the Dundalk and Sparrows Point districts have the highest yields, amounting to about 500 to 900 gallons a minute; industrial wells in the Back River, Highlandtown, and Harbor districts, which are in or near the outcrop of the Patuxent formation, generally have yields of about 200 to 300 gallons a minute. Detailed pumping tests and flow-net analyses show that the coefficient of transmissibility has a wide range, averaging about 20,000 gallons a day per foot in the industrial districts in and near the outcrop area and about 50,000 in the districts in the southeastern part of the industrial area down dip from the outcrop. The coefficient of storage under artesian conditions, according to the most reliable pumping tests in the Sparrows Point district, averages 0.00026; under water-table conditions in the outcrop area it is estimated to be 0.15 to 0.20.

The Patapsco formation yields as much as 500 to 750 gallons of water a minute to industrial wells in the Sparrows Point district, which is the only part of the industrial area where water is now pumped in large quantities from this formation. Pumping tests in the Sparrows Point district show that the coefficient of transmissibility of the aquifer in the lower part of the Patapsco formation is about 25,000 gallons a day per foot. As the thickness of water-bearing material in the upper part of the formation is greater in that district, it is likely that the coefficient of transmissibility of the aquifer in the upper part of the formation there is higher than 25,000.

The large ground-water supplies in the industrial area have been developed since about 1900. The pumpage increased progressively to a peak of about 47,000,000 gallons a day early in 1942; late in 1942 the pumpage was reduced by about 13,000,000 gallons a day; and in 1945 the pumpage was about 34,000,000 gallons a day. The pumpage outside the industrial area increased from about 3,000,000 gallons a day in 1942 to about 5,000,000 gallons a day in 1945. Thus the total pumpage in 1945 for the entire area was 39,000,000 gallons a day. The approximate pumpage, in gallons a day, from each water-bearing formation was: pre-Cambrian crystalline rocks, 1,000,000; Patuxent formation, 30,000,000; Patapsco formation, 6,000,000; and Pleistocene deposits, 3,000,000. Of the total pumpage in 1945 about 85 percent was concentrated in a relatively small part of the area in the industrial districts in and near Baltimore. Owing to the mutual interference of pumping and to the possibility that a pumped well may decrease in efficiency, the yield of wells probably is not uniform throughout a long period of time. To determine accurately the total quantity of water being pumped all wells of large yield should be equipped with some device for determining the yield periodically. This could be done by flow meters, of either nonrecording or recording type, or by use of a timing apparatus that would record the length of time a well is operated. If a timing apparatus is used the yield of the well should be determined periodically so that the total pumpage can be computed by multiplying the yield by the time the well is operated.

Before ground-water supplies were developed in the Baltimore area the artesian head in the aquifers generally was within a few feet of the land surface; but with the progressive increase in pumping, the artesian head declined. In 1942 the artesian head in the Patuxent formation was as much as 160 feet below the land surface; however, the large reduction in pumping in 1942, chiefly in the Sparrows Point district, caused the head to rise so that in most of the industrial area it is now about 40 to 100 feet below the land surface. The artesian head in the Patapsco formation declined progressively, reaching a level of as much as 190 feet below the land surface in 1942 in the Sparrows Point district. The reduction in pumping in this district in 1942 caused the head to rise so that it is now about 10 to 50 feet below the land surface in most of the industrial area. Detailed records of water-level fluctuations in observation wells show that during 1943-45 the general trend of water levels in most parts of the area was either slightly upward or essentially horizontal.

As the record of water-level fluctuations in selected observation wells covers only a short period of time, it would be advisable to continue measurements in many of these wells indefinitely.

The ground water in the Baltimore area normally has a low mineral content, but the lowering of the water table or artesian head produced by pumping has caused local encroachment of brackish water from the Patapsco River estuary in some parts of the industrial area. The area of contamination in the Patuxent formation covers practically all the Harbor district, a large part of the Canton district, and the southern part of the Highlandtown district, and it extends south to the northernmost part of the Fairfield district. The contaminated area in the water-bearing material above the Arundel clay, chiefly the Patapsco formation and Pleistocene deposits, is much larger; it includes large parts of the Canton, Dundalk, Fairfield, and Curtis Bay districts, and practically all the Sparrows Point district. The chloride content within the contaminated areas is not uniform; it may be as low as the arbitrarily selected lower limit of 15 parts per million and as high as 4,000 to 5,000 parts per million.

Industrial wastes, chiefly sulfuric acid, have contaminated the ground water in the Canton district, and the contaminated water has moved northward to the southern part of the Highlandtown district. The acid has come from acid plants and other industries in the Canton district at one time or another during the past 100 years, and from oxidation of sulfur in slag dumped in some parts of the district many years ago. Protective pumping from the shallow aquifers at certain localities in the Canton district probably would prevent a large part of the acid contamination from reaching the Patuxent formation.

Although salt-water contamination due tc local encroachment, chiefly from the Patapsco River estuary, has developed during a period of 50 years or more, most parts of the aquifers were contaminated between 1920 and 1940, the period of heavy ground-water development.

With the available data it is not possible to determine accurately whether the area of contamination in the Patuxent formation is expanding appreciably. The pattern of flow lines based on the piezometric contours suggests that a large part of the contaminated water is being removed by pumping in the Harbor district, but some contaminated water is moving toward the Highlandtown district and may be moving southeastward toward the Dundalk district. The degree of contamination, due to salt-water encroachment, in the Patuxent formation in the southeastern part of the industrial area is not likely ever to be as high as that in the Harbor and Canton districts. The Patapsco formation is much more susceptible to contamination by encroachment of salt water from the Patapsco River estuary. As the water levels in wells ending in that formation are below the level of the estuary in a large part of the industrial area, salt water is still entering the formation. With the present pattern of pumping the area of contamination probably will not increase much beyond its present size, but it is likely that the degree of salinity will increase gradually at some localities.

Contamination through defective wells that penetrate the shallow contaminated aquifers above the Arundel clay and extend into the fresh-water aquifer in the Patuxent formation is one of the most serious ground-water problems in the industrial area. The highly mineralized water is leaking both through unplugged abandoned wells and through wells still in use. Through careful repair of active wells and effective plugging of accessible abandoned wells, most of this contamination can be reduced so as to decrease appreciably, within a relatively short time, the mineral content of water pumped from many of the major well fields.

The location and plugging of abandoned wells that are covered and no longer accessible presents a difficult problem, but every effort should be made to locate and plug as many as practicable. The casings of all new wells drilled in the contaminated area should be cemented in order to prevent or delay corrosion and development of salt-water leaks.

The water pumped from the Patuxent formation, the major aquifer in the industrial area, is derived from recharge on the outcrop of the formation. The potential rate of recharge exceeds the theoretical maximum quantity of water that can be transmitted through the formation. Therefore the rate of recharge is not an important factor in limiting the quantity of water that can be withdrawn from the artesian part of the aquifer.

The concentration of pumping has caused the water table or artesian head to be so low in and near the centers of pumping in the Back River, Highlandtown, Curtis Bay, and Fairfield districts, that very little additional water can be developed from the Patuxent formation in those parts of the districts. However, the water table or artesian head between the centers of pumping is relatively high, and additional water could be pumped from the Patuxent formation if the wells were spaced at greater distances.

The heavy pumping from the Patuxent formation, chiefly in the Harbor district, has caused local encroachment of salt water, and in this respect the "safe yield" of the formation would appear to have been exceeded. It would not be advisable, however, to decrease or stop pumping in the Harbor district; if this were done the contaminated water now in the formation could move readily to the centers of pumping in other industrial districts. A program of artificial recharge through wells and protective pumping might prevent additional salt water from entering the formation in the Harbor district, but considerably more detailed geologic and hydrologic data would have to be obtained before the practicability of such a scheme could be determined.

The quantity of water that can be pumped from the Patapsco formation in the industrial area is limited by the transmissibility of the formation and not by the potential rate of recharge. Heavy pumping over a period of many years throughout the industrial area has caused local encroachment of salt water, chiefly from the Patapsco River estuary. Owing to this contamination practically all pumping from the Patapsco formation in the Dundalk, Fairfield, and Curtis Bay districts has been discontinued. The present pumping, which is chiefly from the aquifer in the lower part of the formation in the Sparrows Point district, is still inducing encroachment of salt water. However, the Sparrows Point district is farther down dip than the other districts; consequently a large part of the water pumped from this aquifer is derived from areas in which water in the aquifer is fresh. Although the degree of salinity in some parts of the contaminated area may increase, the areal extent of the contamination probably will not increase much beyond its present size. The question of whether it would be desirable to reduce pumping from the Patapsco formation so as to prevent further encroachment of salt water cannot be answered solely in terms of the effect of a reduction on the Patapsco formation itself. If pumping were stopped, the accompanying increase in head would cause an increase in the flow of salt water through leaking wells to the Patuxent formation; moreover, many decades would pass before the salt water in the Patapsco formation would be flushed out. In any event, it would not be advisable to reduce the present pumping from the Patapsco formation until the wells that leak salt water to the Patuxent formation have been repaired or plugged, nor to develop additional ground-water supplies from the Patapsco formation in the Curtis Bay, Fairfield, and Dundalk districts, which are near the main source of contamination.

The safe yield of an aquifer generally has been considered as the quantity of water that can be withdrawn indefinitely without lowering the water levels to uneconomical limits or without impairing the quality of the water. However, the economic value of ground water in the industrial area is different for various types of uses, and there is little or no uniformity in the chemical quality of the water that can be used. Therefore, the application of the term "safe yield" in the sense that it represents a single rate of pumping, would be unrealistic. Owing to the contamination of the water, however, the safe yield has been exceeded for some industries. Those industries have abandoned their well fields and now obtain water from the Baltimore public supply. It is possible that in the future other industries will have to obtain water from the Baltimore public supply, particularly if leaking wells are not plugged or repaired.

If the industrial area is considered in its entirety, additional supplies of water can be developed if the pumping is distributed more evenly. The practicability of such development, however, is a matter of economics.

RECORDS OF WELLS

The records of wells in the following Table 15 are based on information obtained from many sources and are of varying degree of completeness and accuracy. The wells are located as accurately as possible, but many old wells in the industrial districts in and near Baltimore are no longer visible and can be located only approximately.

The well numbers on the left side of the table are those on the well-location maps (Pls. 1, 3, and 4). Those wells for which locations are too uncertain to be shown on the well-location maps, were not assigned numbers.

The symbol *a* in the water level column indicates reported water level.

The symbols in the pumping equipment column indicate: A, air lift; H, hand; I, impeller (turbine or centrifugal); N, none; R, reciprocating.

The symbols in the use of water column indicate: D, domestic; I, industrial; M, military; N, not used; P, public.

TABLE

Records of Wells

Location number	Owner or name	Driller	Date completed	Approximate altitude (feet)	Depth (feet)	Casing diameter (inches)	Depth of screen below land surface (feet)	Principal water-bearing formation	
								Character of material	Geologic age
	C. H. Brooks (Brooklyn)	Craig	1906	60	85	4	-	-	-
	Car Shops (Curtis Bay)	-	-	-	65	-	-	Sand and/or gravel	Patapsco
	Carstairs Bros. Distilling Co. (Highlandtown)	Shannahan	1906	-	198	-	-	do	Patuxent
	Do	do	do	-	240	-	-	do	do
	Claremont Abattoir	Downin	1903	90	48	6	-	Hard rock	Pre-Cambrian
	Do	do	Before 1896	90	82	6	-	do	do
	Consolidated Gas, Electric Light & Power Co.	-	-	-	-	-	-	-	-
	Davison Chemical Corp.	Downin	1903	90	139	6	-	Hard rock	Pre-Cambrian
	Do	do	do	90	101	6	-	do	do
	Ellis Co. (Brooklyn)	Willigan	1908	10	325	6	-	Sand and/or gravel	Patuxent
	John T. Flood	-	1888	5	-	2	-	-	-
	Furst Concrete Scow Mfg. Co.-(Fairfield)	Shannahan	1912	-	309	-	-	Sand and/or gravel	Patuxent
	John Gills	Downin	1885	-	-	-	-	-	-
	Greenwald Packing Co. (Claremont)	do	-	80	196	6	-	Hard rock	Pre-Cambrian
	Do	do	-	80	196	6	-	do	do
	Lewis Grienensen (Brooklyn)	Craig	-	40	55	4	-	-	-
	R. B. Hopkins	-	-	-	-	-	-	-	-
	Mr. Neifield	Hoshall	1922	-	270	6	-	Hard rock	Pre-Cambrian
	Do	do	1925	-	169	6	-	do	do
	Numsen	Downin	-	400	82	6	-	do	do
	C. H. Pearson & Co.	-	Before 1896	-	102	-	-	-	-
1S1E-1	Independent Ice Co.	Harper	1907	15	125	8	-	Hard rock	Pre-Cambrian
2	Do	Downin	1894	15	125	8	-	do	do
3	Do	-	-	15	30(?)	8	-	Sand and/or gravel	Pleistocene(?)
4	Do	-	-	15	30(?)	8	-	do	do
5	Do	-	-	15	30(?)	8	-	do	do
6	Do	-	-	15	30(?)	8	-	do	do
7	Globe Brewing Co.	-	Before 1896	20	197	6	-	Hard rock	Pre-Cambrian
8	Hendler Creamery Co.	-	-	22	27	72	-	Sand and/or gravel	Pleistocene(?)
9	Do	-	-	22	35(?)	72	-	do	do
10	Do	-	-	22	35	72	-	do	do

[a]Reported water level.

15

in the Baltimore Area

Water level (feet below land surface)			Pumping equipment	Depth of pump below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Pumping	Static	Date			Gallons a minute	Date				
-	[a]20	-	-	-	9	-	-	-	-	Exact location unknown.
-	[a]20	-	-	-	-	-	-	N	-	Exact location unknown. Ample yield reported.
-	[a]90	-	-	-	-	-	-	N	-	Exact location unknown.
-	[a]80	-	-	-	-	-	-	N	-	Do.
-	-	-	-	-	12	-	-	N	-	Exact location unknown. Contamination reported.
-	-	-	-	-	70	1918	-	A	-	Exact location unknown.
-	-	-	-	-	-	-	-	N	-	Eight wells; exact location unknown.
-	-	-	-	-	75	-	-	AN	-	Exact location unknown.
-	-	-	-	-	75	-	-	AN	-	Do.
-	[a]5	-	-	-	100	-	-	-	-	Do.
-	-	-	-	-	-	-	-	-	-	Do.
-	[a]9	-	-	-	-	-	-	-	-	Do.
-	[a]16	-	-	-	-	-	-	-	-	Exact location unknown. Ample yield reported.
-	-	-	-	-	130	-	-	-	-	Exact location unknown.
-	-	-	-	-	12	-	-	-	-	Do.
-	-	-	-	-	-	-	-	-	-	Do.
-	-	-	-	-	-	-	-	-	-	Two wells, exact location unknown.
-	-	-	-	-	3	-	-	-	-	Exact location unknown.
-	-	-	-	-	30	-	-	-	-	Do.
-	-	-	-	-	18	-	-	-	-	Do.
-	-	-	-	-	-	-	-	-	-	Do.
-	-	-	N	-	0	-	-	N	-	Hard rock at 60 feet.
-	[a]17	-	I	-	65	-	-	I	-	See table of analyses. Hard rock at 60 feet.
-	-	-	N	-	-	-	-	N	-	
-	-	-	N	-	-	-	-	N	-	
-	-	-	N	-	-	-	-	N	-	
-	-	-	N	-	-	-	-	N	-	
-	-	-	N	-	10	-	-	N	-	Well covered; exact location unknown.
36.50	-	June 13, 1944	R	27	15	June 13, 1944	-	I	60	Owner's dug well "Front-cellar well." See table of analyses.
-	-	-	R	35	15	do	-	I	-	Owner's dug well "Boiler-room well." See table of analyses
35.19	-	June 13, 1944	R	-	15	do	-	I	-	Owner's dug well "Engine-room well." See table of analyses.

TABLE 15—

Location number	Owner or name	Driller	Date completed	Approximate altitude (feet)	Depth (feet)	Casing diameter (inches)	Depth of screen below land surface (feet)	Principal water-bearing formation: Character of material	Principal water-bearing formation: Geologic age
1S1E-11	Hendler Creamery Co.	-	-	22	38	72	-	Sand and/or gravel	Pleistocene(?)
12	Do	-	-	22	35(?)	72	-	do	do
13	Do	-	-	22	35	72	-	do	do
14	Bird & Sona	-	Before 1896	15	320	8	-	Hard rock	Pre-Cambrian
15	Emeraoo Hotel	Harper	1911	15	90	10	-	do	do
16	H. L. Carpel Co.	-	Before 1896	10	90	-	-	Sand and/or gravel	Patuxent and/or Pleiatocene
17	Miller Chemical & Fertilizer Corp.	-	do	10	50(?)	8	-	Gravel	Patuxent
18	Do	-	do	10	50(?)	8	-	do	do
19	Do	-	do	10	50(?)	8	-	do	do
20	Do	-	do	10	50(?)	8	-	do	do
21	Do	-	do	10	50(?)	8	-	do	do
22	Do	-	do	10	50(?)	8	-	do	do
23	Do	-	do	10	50(?)	8	-	do	do
24	City of Baltimore	-	do	15	50	-	-	do	Patuxent and/or Pleistocene
25	-	-	-	10	112	3	-	do	do
26	Darby Candy Co.	Harper	1907	15	300	8	-	Hard rock	Pre-Cambrian
27	L. Elmer & Sons	-	Before 1918	10	35	-	-	Sand and/or gravel	Patuxent and/or Pleiatocene
28	Do	-	do	10	35	-	-	do	do
29	Do	-	do	10	35	-	-	do	do
30	Do	-	do	10	55	-	-	do	do
31	Do	-	do	10	55	-	-	do	do
32	Do	-	do	10	55	-	-	do	do
33	Do	-	do	10	55	-	-	do	do
34	Do	-	do	10	55	-	-	do	do
35	Do	-	do	10	60	4½	-	do	do
36	Do	Miller	1909	10	72	6	-	do	do
37	Do	do	do	10	72	6	-	do	do
38	Do	do	do	10	72	6	-	do	do
39	Do	do	do	10	72	4½	-	do	do
40	Do	do	do	10	72	4½	-	do	do
41	Do	do	do	10	72	4½	-	do	do
42	Gail & Ax	Redpath & Potter	Before 1918	20	380	6	-	Gneiaa	Pre-Cambrian
43	Gardiner Dairy Co.	do	Before 1910	20	600	-	-	Hard rock	do

Continued

Water level (feet below land surface)			Pumping equipment	Depth of pump below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Pumping	Static	Date			Gallons a minute	Date				
36.82	-	June 13, 1944	R	38	15	June 13, 1944	-	I	-	Owner's dug well "West well in garage." See table of analyses.
-	-	-	N	-	-	-	-	N	-	Owner's dug well "East well in garage."
-	-	-	N	-	-	-	-	N	-	Dug well; filled with cinders and covered.
-	-	-	N	-	0	1896	-	N	-	Well covered; exact location unknown.
-	[a]35	-	N	-	40	-	-	N	-	Well capped. See table of well logs.
-	[a]3	-	N	-	-	-	-	N	-	Well covered; exact location unknown. Ample yield reported.
-	-	-	N	-	-	-	-	N	-	Well covered; exact location unknown. See log.
-	-	-	N	-	-	-	-	N	-	Well covered; exact location unknown.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Exact location uoknown. Ample supply reported.
-	-	-	N	-	-	-	-	N	-	Exact location unknown. Water reported to be of poor quality. Hard rock at 112 feet. Filled to 70 feet.
-	-	-	N	-	-	-	-	N	-	Exact locatioo unknown. Ample supply reported. Poor quality.
-	-	-	N	-	5	-	-	N	-	Exact location unknown.
-	-	-	N	-	5	-	-	N	-	Do.
-	-	-	N	-	5	-	-	N	-	Do.
-	-	-	N	-	0	-	-	N	-	Do.
-	-	-	N	-	0	-	-	N	-	Do.
-	-	-	N	-	0	-	-	N	-	Do.
-	-	-	N	-	0	-	-	N	-	Do.
-	-	-	N	-	0	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Exact location unknown. Ample supply reported.
-	[a]15	-	N	-	20	-	-	N	60	Exact location unknown.
-	[a]15	-	N	-	20	-	-	N	60	Do.
-	[a]15	-	N	-	20	-	-	N	60	Do.
-	[a]15	-	N	-	20	-	-	N	-	Do.
-	[a]15	-	N	-	20	-	-	N	-	Do.
-	[a]15	-	N	-	20	-	-	N	-	Do.
-	-	-	N	-	0	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Exact location unknown. Small yield reported.

TABLE 15—

Location number	Owner or name	Driller	Date completed	Approximate altitude (feet)	Depth (feet)	Casing diameter (inches)	Depth of screen below land surface (feet)	Principal water-bearing formation: Character of material	Principal water-bearing formation: Geologic age
1S1E-44	Kingham Provision Co.	Downin	1895	18	240	4	-	Hard rock	Pre-Cambrian
45	Do	-	1911	18	100	6	-	do	do
46	Maltby Estate	-	Before 1896	10	100	12-10	-	do	Pre-Cambrian(?)
47	Wagner Co.	-	do	10	100	6	-	do	do
48	Do	-	do	10	100	1½	-	do	do
49	McCormick & Sons	Hoshall	1916	10	192	8	-	do	Pre-Cambrian
50	Do	do	do	10	192	8	-	do	do
-	American Building	-	-	-	-	-	-	-	-
-	Flour Mills	-	Before 1896	-	-	-	-	-	-
-	Horn Ice Cream Co.	-	-	-	-	-	-	-	-
-	Robins Butter Co.	-	-	-	-	-	-	-	-
1S2E-1	American Ice Co.	Downin	1905	38	135	4½	-	Sand and/or gravel	Patuxent
2	Do	do	1906	38	165	6	90-94	do	do
3	Do	do	1909	38	125	8	90-100	do	do
4	Do	do	1911	38	90	6	-	Sand and gravel	do
5	J. Langrall & Bro., Inc.	Shannahan	Before 1896	5	112	6	-	Sand and/or gravel	do
6	Do	do	1904	5	90	8	-	do	do
7	McKenna Pontiac Co.	-	Before 1896	25	80	12	-	do	do
8	G.M.C. Truck & Coach Div.	-	Before 1918	10	70	10	-	do	Pleistocene(?)
9	Bohemian Church	-	1898	15	22	60	-	do	Pleistocene
10	Gas Works	-	Before 1896	58	-	-	-	do	Patuxent
1S3E-1	Pennsylvania Water & Power Co.	-	1911(?)	40	199	6	-	Gneiss	Pre-Cambrian
2	Wm. Schluderberg - T.J. Kurdle Co.	-	1929	60	195	-	-	Sand and gravel	Patuxent
3	Do	Layne-Atlantic	1941	60	272	18-8	150-160 170-190 225-245 262-267	do	do
4	Do	do	1943	55	195	8	146-156 170-180	do	do
5	Monarch Rubber Co.	Harr	1937	38	104	8-6	90-100(?)	Sand and/or gravel	do
6	Paul Jones & Co., Inc.	Keystone	1933	45	145	6	-	do	do

Continued

Water level (feet below land surface)			Pumping equipment	Depth of pump below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Pumping	Static	Date			Gallons a minute	Date				
-	[a]12	-	N	-	40	-	-	N	-	Exact location unknown. Water reported to be of poor quality.
-	-	-	N	-	-	-	-	N	-	Exact location unknown. Hard rock at 26 feet.
-	-	-	N	-	40	-	-	N	-	Exact location unknown.
-	[a]7	-	N	-	50	-	-	N	-	Do.
-	[a]7	-	N	-	30	-	-	N	-	Do.
-	-	-	-	-	8	-	-	N	-	Do.
-	-	-	-	-	8	-	-	N	-	Do.
-	-	-	-	-	-	-	-	-	-	Do.
-	-	-	-	-	-	-	-	-	-	Group of three wells; exact location unknown. Water reported of poor quality.
-	-	-	-	-	-	-	-	-	-	Exact location unknown.
-	-	-	-	-	-	-	-	-	-	Do.
-	[a]35	-	N	-	20	-	-	N	-	Well covered. Hard rock at 96 feet.
-	[a]35	-	N	-	45	-	-	N	-	Hard rock at 95 feet.
-	[a]35	-	N	-	35	-	-	N	-	Well covered. Hard rock at 95 feet.
-	[a]30	-	N	-	50	-	-	N	-	Well covered.
-	-	-	N	-	100	-	-	N	-	Well capped.
-	-	-	N	-	100	-	-	N	-	Well plugged and covered. Water reported to be contaminated by river water.
-	[a]20.5	-	N	-	500	Before 1910	-	N	-	Well covered by building. Exact location unknown.
-	[a]1	-	N	-	-	-	-	N	-	Do.
-	[a]18	-	N	-	-	-	-	N	-	Dug well. Ample supply reported.
-	-	-	-	-	-	-	-	-	-	
-	[a]77	1939	R	-	20	-	-	I	-	See tables of well logs and analyses. Capacity of pump, 20 gal. a min.
[a]142	[a]76	1928	I	160	400	Oct. 1928	6	I	-	Owner's well 2. See tables of well logs and analyses.
[a]180	[a]65	June 6, 1941	I	180	320 250	1941 1943	2.8	I	-	Owner's well 3. See tables of well logs and analyses. Depth of footpiece in well, 200 feet.
170	110.54	Apr. 9, 1943	I	150	125	Apr. 9, 1943	2	I	57	Owner's well 4. Depth of footpiece in well 170 feet. See tables of well logs and analyses.
-	[a]55	April 1943	R	90	35	1943	-	I	58	See table of analyses.
-	[a]95	January 1941	I	-	85	do	-	I	-	Do.

TABLE 15—

Location number	Owner or name	Driller	Date completed	Approximate altitude (feet)	Depth (feet)	Casing diameter (inches)	Depth of screen below land surface (feet)	Principal water-bearing formation	
								Character of material	Geologic age
1S3E-7	Paul Jones & Co., Inc.	Keystone	1933	60	153	6	-	Sand and gravel	do
8	Wm. Schluderberg - T.J. Kurdle Co.	Layne-Atlantic	1939	60	211	-	-	do	do
9	Highlandtown Ice Co.	-	1906(?)	90	257	6(?)	-	Sand and/or gravel	Patuxent
10	Do	-	do	90	262	6(?)	-	do	do
11	Do	-	do	90	90	6(?)	-	Sandy clay	do
12	Kimball Tyler Co.	-	Before 1925	58	183	6	-	Sand and gravel	do
13	T.J. Kurdle	-	Before 1909	70	110	4	-	Sand and/or gravel	do
14	Do	Newkirk	1909	70	210	6-4	-	Sand and gravel	do
15	Schluderberg Packing Co.	-	Before 1918	80	408	-	-	Hard rock	Pre-Cambrian
16	Do	-	-	85	310	6	-	Limestone	do
17	Do	-	-	85	290	6	-	do	do
18	Sellmayer Packing Co.	-	-	85	260	-	-	do	do
19	Wm. Schluderberg - T.J. Kurdle Co.	Layne-Atlantic	-	55	153	12-8	-	Sand and gravel	Patuxent
20	Do	do	-	55	152(?)	12-8	-	Sand and/or gravel	do
21	Monumental Brewing Co.	Rust	1910	60	535	8	-	Gneiss	Pre-Cambrian
22	Do	do	1900	60	480	10	-	Hard rock	do
23	Do	-	-	60	400	-	-	do	do
24	Do	-	-	60	400	-	-	do	do
25	Do	-	-	60	400	-	-	do	do
26	Ice Box Mfg. Co.	Rust	1904	60	205	3½	-	Sand and/or gravel	Patuxent(?)
27	Do	-	do	60	188	4	-	do	do
28	Helwig & Leitch, Inc.	-	-	50	147	4	-	do	do
29	Eastern Welding & Radiator Co.	-	-	80	197	6-4	-	do	do
30	Do	-	-	80	197	6-4	-	do	do
31	Do	-	-	80	197	6-4	-	do	do
32	Do	-	-	80	202	6-4	-	do	do
33	Do	-	-	80	202	6-4	-	do	do
34	Canton Ice Co.	Rust	1910	85	400	6	-	Sand and gravel	do
35	City of Baltimore	Miller	1903	85	63	5	-	Gravel	do

Continued

Water level (feet below land surface)			Pumping equipment	Depth of pump below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Pumping	Static	Date			Gallons a minute	Date				
[a]138	[a]86 [a]101	July 1934 July 1941	I	-	85	1943	1.6	I	-	See tables of well logs and analyses.
-	[a]118	-	N	-	60	-	-	N	-	Owner's well 1; well plugged. See table of well logs.
-	-	-	N	-	-	-	-	N	-	Well covered. Small yield reported. See table of analyses.
-	-	-	N	-	-	-	-	N	-	Well covered. Small yield reported.
-	-	-	N	-	-	-	-	N	-	Well covered. Small yield reported. See table of well logs.
-	119.14	Mar. 14, 1944	A	-	40	-	-	N	-	See table of well logs.
-	[a]40	-	N	-	50	-	-	N	-	Well covered; exact location unknown.
-	[a]60	-	N	-	150	-	-	N	-	Do.
-	[a]98	-	N	-	150	-	-	N	-	Well covered; exact location unknown. See tables of well logs and analyses.
-	-	-	N	-	200	-	-	N	-	Well covered; exact location unknown. See table of well logs.
-	-	-	N	-	80	-	-	N	-	Do.
-	-	-	N	-	150	-	-	N	-	Well covered; exact location unknown. See table of analyses.
-	-	-	N	-	150	-	2	N	-	Well capped and covered. See table of well logs.
-	-	-	N	-	150	-	-	N	-	Well capped and covered. See table of analyses.
-	-	-	N	-	175	-	-	N	-	Exact location unknown. See tables of well logs and analyses.
-	[a]80	-	N	-	150	-	-	N	-	Exact location unknown. See table of analyses.
-	-	-	N	-	350	-	-	N	-	Exact location unknown.
-	-	-	N	-	350	-	-	N	-	Do.
-	-	-	N	-	350	-	-	N	-	Do.
-	-	-	N	-	17	-	-	N	-	Well covered; exact location unknown.
-	[a]46	-	N	-	15	-	-	N	-	Do.
-	109.30	June 29, 1944	N	-	-	-	-	N	-	
-	[a]54	-	N	-	100	-	-	N	-	Well covered; exact location unknown.
-	[a]54	-	N	-	100	-	-	N	-	Do.
-	[a]54	-	N	-	100	-	-	N	-	Do.
-	[a]54	-	N	-	100	-	-	N	-	Do.
-	[a]54	-	N	-	100	-	-	N	-	Do.
-	-	-	-	-	75	-	-	N	-	Exact location unknown. See table of well logs.
-	[a]58	-	-	-	30	-	-	N	-	Exact location unknown.

TABLE 15—

Location number	Owner or name	Driller	Date completed	Approximate altitude (feet)	Depth (feet)	Casing diameter (inches)	Depth of screen below land surface (feet)	Principal water-bearing formation: Character of material	Principal water-bearing formation: Geologic age
1S3E-36	Consolidated Gas, Electric Light & Power Co.	-	1894	20	66	6	-	Sand and/or gravel	Patuxent
37	Do	-	-	60	-	-	-	-	Patuxent(?)
38	G. W. Gengnagel	-	-	85	196	4½	-	Sand and/or gravel	do
39	Steiner Mantel Co.	Downin	1906	60	120	2	-	do	do
40	-	-	-	60	195	-	-	do	do
41	Monarch Rubber Co.	Columbia Pump & Well Co.	1945	40	100	6	90-100	Sand	Patuxent
-	Rome Co.	-	-	-	-	-	-	-	-
1S4E-1	Crown Cork & Seal Co.	Harris-Harmon	1939	55	233	-	-	Sand and gravel	Patuxent
2	Do	do	1941	66	215	24	-	do	do
3	Maryland Sanitary Mfg. Co.	Downin	1903	60	263	6	-	Gneiss	Pre-Cambrian
4	Do	O'Donovan	1896	60	163	-	-	Sand and/or gravel	Patuxent
5	Do	-	-	-	60	6½	-	do	do
6	Do	-	1920(?)	65	225	-	-	Hard rock	Pre-Cambrian
7	Do	-	do	62	200(?)	-	-	do	do
8	Atlantic Wastepaper Co.	Downin	1907	58	172	6	-	do	do
9	Do	-	-	58	139	6	-	Sand and/or gravel	Patuxent
10	Pennsylvania Railroad	-	1892	60	82	8	-	do	do
11	Crown Cork & Seal Co.	-	-	55	175	-	-	Gravel	do
12	Do	Shannahan	1930	60	224	-	-	Sand and/or gravel	do
13	Do	do	1934	60	200±	-	-	do	do
14	Do	do	1935	60	207	-	-	do	do
15	Do	do	1937	60	184	-	-	do	do
16	Wienecke Arey Co.	-	-	100	420	6-4	-	Hard rock	Pre-Cambrian
17	Geo. Berderine	Hoshall	-	100	225	6	-	Sand and/or gravel	Patuxent
18	Crown Cork & Seal Co.	Shannahan	1904	60	204	6	-	do	do
19	Do	Layne-Atlantic	1945	-	-	-	-	Sand and gravel	do
2S1E-1	Chesapeake Paperboard Co.	do	1934	20	150	10	-	Sand and/or gravel	do

Continued

Water level (feet below land surface)			Pumping equipment	Depth of pump below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Pumping	Static	Date			Gallons a minute	Date				
-	[a]17	-	H	-	65	-	-	N	-	
-	-	-	-	-	-	-	-	N	-	Exact location unknown.
-	[a]88	-	-	-	-	-	-	N	-	Exact location unknown. Ample supply reported.
-	[a]3	-	N	-	3	-	-	N	-	Exact location unknown.
-	-	-	N	-	-	-	-	N	-	Do.
-	62.32	Oct. 16, 1945	N	-	40	1945	-	N	-	See table of well logs.
-	-	-	-	-	-	-	-	-	-	
[a]150	[a]120	-	I	160	500	-	16.6	I	57½	Owner's well 1. See tables of well logs and analyses.
167	-	Apr. 1, 1943	I	-	400	-	-	I	-	Owner's well 3. See tables of well logs and analyses.
-	-	-	N	-	-	-	-	N	-	Well covered; exact location unknown. See table of well logs.
-	[a]4	-	N	-	8	-	-	N	-	Well covered; exact location unknown.
-	-	-	N	-	0	-	-	N	-	Do.
-	[a]Flowed	1925	N	-	5	1925	-	N	-	Well covered.
-	-	-	N	-	0	-	-	N	-	Do.
-	[a]40	-	N	-	50	-	-	N	-	Well filled with debris.
-	94.29	Nov. 18, 1944	A	-	-	-	-	N	-	See table of analyses.
-	[a]40(?)	-	N	-	62	-	-	N	-	Well covered; exact location unknown.
-	-	-	N	-	1,000	-	-	N	-	Well plugged; exact location unknown.
-	[a]84	1930	N	-	900 450	1930 1938	-	N	-	Owner's well Old-1. Well plugged; exact location unknown.
-	-	-	N	-	450 270	1934 1938	-	N	-	Owner's well Old-2. Well plugged; exact location unknown.
-	[a]117	1935	N	-	450 300 150	1936 1938 1940	-	N	-	Owner's well Old-3. Well plugged; exact location unknown.
-	[a]125	1937	N	-	200 450	1937 -	-	N	-	Owner's well Old-4. Well plugged; exact location unknown.
-	[a]200	-	N	-	40	-	-	N	-	Exact location unknown. Rock at 220 feet.
-	-	-	N	-	0	-	-	N	-	Exact location unknown.
-	[a]50	1904	N	-	125	-	-	N	-	Well plugged; exact location unknown. See table of analyses.
-	-	-	-	-	-	-	-	-	-	See tables of well logs and analyses.
-	-	-	I	120	250	1943	-	I	-	Owner's well 2. See table of analyses.

TABLE 15—

Location number	Owner or name	Driller	Date completed	Approximate altitude (feet)	Depth (feet)	Casing diameter (inches)	Depth of screen below land surface (feet)	Principal water-bearing formation	
								Character of material	Geologic age
2S1E-2	Chesapeake Paperboard Co.	Layne-Atlantic	-	20	150	10	-	Sand and/or gravel	Patuxent
3	Do	do	1934	20	161	38-8	-	do	do
4	James Distillery	Harr	1936	10	40	6	35-40	do	do
5	Do	do	do	10	60	6	55-60	do	do
6	Do	-	Before 1930	10	-	8	-	-	-
7	Do	-	-	10	-	3(?)	-	-	-
8	Kriel Packing Co.	-	1929	42	105	-	-	Sand and/or gravel	Patuxent
9	Do	-	do	42	526	-	-	Hard rock	Pre-Cambrian
10	Do	-	do	42	-	-	-	-	-
11	Knox Net & Twine Co.	-	-	50	-	-	-	-	-
12	Do	-	-	50	-	-	-	-	-
13	Booz Bros., Inc.	Miller	1879	5	115	8	-	Sand and/or gravel	Patuxent
14	Platt Corp.	Downin	-	5	119	-	-	do	do
15	Do	do	1904	5	110	6	-	do	do
16	Buck Glass Co.	Hoshall	1923	30	119	8	-	Sand and gravel	do
17	American Sugar Refining Co.	Miller	1905	5	109	4	-	Gravel	do
18	Brooks Transportation Co.	-	1899	5	110	6	-	Sand and gravel	do
19	Do	-	do	5	110	6	-	do	do
20	Do	-	do	5	110	6	-	do	do
21	Do	-	do	5	110	6	-	do	do
22	Do	-	do	5	136	6	-	do	do
23	Do	-	do	5	136	6	-	do	do
24	Do	-	do	5	136	6	-	do	do
25	Do	-	do	5	136	6	-	do	do
26	Maltby Estate	-	-	0	900	-	-	Hard rock	Pre-Cambrian
27	Atlantic Wholesale Grocery Co.	Downin	1901	10	150	6	-	Sand and/or gravel	Patuxent
28	Do	do	do	10	150	6	-	do	do
29	Do	do	do	10	150	6	-	do	do
30	Do	do	do	10	150	6	-	do	do
31	Do	do	do	10	150	6	-	do	do
32	Do	do	do	10	150	6	-	do	do
33	Do	do	do	10	150	6	-	do	do
34	Do	do	do	10	150	6	-	do	do
35	Bethlehem Steel Co. Baltimore Yard	-	Before 1896	10	58	1¼	-	do	do
36	Do	-	do	10	65	4	-	do	do

Continued

Water level (feet below land surface)			Pumping equipment	Depth of pump below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Pumping	Static	Date			Gallons a minute	Date				
-	-	-	I	-	350	1943	-	I	-	Owner's well 3. See table of analyses.
-	a27	April 1934	N	-	-	-	-	N	-	Well covered. Quality of water reported poor. See table of well logs.
-	-	-	I	35	100	-	-	I	60.5	See table of analyses.
-	-	-	I	55	0	1944	-	N	-	Owner's well 2. See table of analyses.
-	-	-	N	-	-	-	-	N	-	Owner's well 3. Rock at 35 feet.
-	-	-	N	-	-	-	-	N	-	Owner's well 4, well capped.
-	-	-	N	-	-	-	-	N	-	
-	-	-	N	-	-	-	-	N	-	
-	-	-	N	-	-	-	-	N	-	
-	-	-	N	-	-	-	-	N	-	Well plugged with cement.
-	-	-	N	-	-	-	-	N	-	Do.
-	a6	-	N	-	16	-	-	N	-	Well covered.
-	-	-	N	-	60	-	-	N	-	Do.
-	a6	-	N	-	40	-	-	N	-	Do.
-	49.96	Jan. 25, 1945	N	-	58	-	-	N	-	Equipped with water-stage recorder. See tables of well logs and analyses.
-	a13	-	N	-	-	-	-	N	-	Well covered; exact location unknown. Water formed scale in boilers.
-	a5	-	N	-	77	-	-	N	-	Well covered.
-	a5	-	N	-	77	-	-	N	-	Do.
-	a5	-	N	-	77	-	-	N	-	Do.
-	a5	-	N	-	77	-	-	N	-	Do.
-	a5	-	N	-	77	-	-	N	-	Do.
-	a5	-	N	-	77	-	-	N	-	Do.
-	a5	-	N	-	77	-	-	N	-	Do.
-	a5	-	N	-	77	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Well covered; exact location unknown.
-	a20	-	N	-	31	-	-	N	56	Well covered; exact location unknown. Water reported contaminated with salt water. Well filled to 90 feet.
-	a20	-	N	-	31	-	-	N	-	Do.
-	a20	-	N	-	31	-	-	N	-	Do.
-	a20	-	N	-	31	-	-	N	-	Do.
-	a20	-	N	-	31	-	-	N	-	Do.
-	a20	-	N	-	31	-	-	N	-	Do.
-	a20	-	N	-	31	-	-	N	-	Do.
-	a20	-	N	-	31	-	-	N	-	Do.
-	a18	-	N	-	-	-	-	N	-	Well covered; exact location unknown.
-	a6	-	N	-	-	-	-	N	-	Do.

TABLE 15-

Location number	Owner or name	Driller	Date completed	Approximate altitude (feet)	Depth (feet)	Casing diameter (inches)	Depth of screen below land surface (feet)	Principal water-bearing formation: Character of material	Principal water-bearing formation: Geologic age
2S1E-37	Baltimore Copper Paint Co.	-	-	15	-	-	-	-	-
38	Bethlehem Steel Co. Baltimore Yard	-	-	10	-	-	-	-	-
39	Ellicott Furnace Co.	-	-	40	-	-	-	-	-
40	Red Coil Co.	Ruat	1895	10	138	6	128-138	Sand and/or gravel	Patuxent
41	Mutual Chemical Co.	-	1902	8	-	6	-	do	Pleistocene
42	Do	-	do	8	-	-	-	-	-
43	Do	-	do	8	120	-	-	-	-
44	Do	-	do	8	100	-	-	Sand and/or gravel	Patuxent
45	Do	-	do	8	120	-	-	do	do
46	Do	-	do	8	-	-	-	-	-
47	Do	-	do	8	100	-	-	Sand and/or gravel	Patuxent
48	Do	-	do	8	140	6	-	do	do
49	Do	-	do	8	-	-	-	-	-
50	Do	-	do	8	-	-	-	-	-
51	Do	-	do	8	-	-	-	-	-
52	Do	-	do	8	-	-	-	-	-
53	Do	-	do	8	-	-	-	-	-
54	Do	-	do	8	-	-	-	-	-
55	Do	-	do	8	-	-	-	-	-
56	Do	-	do	8	-	-	-	-	-
57	Do	-	do	8	-	-	-	-	-
58	Do	-	do	8	-	-	-	-	-
59	Do	-	do	8	-	-	-	-	-
60	Do	-	do	8	-	-	-	-	-
61	Do	-	do	8	-	-	-	-	-
62	Do	-	do	8	-	-	-	-	-
63	Do	-	do	8	-	-	-	-	-
64	Do	-	do	8	-	-	-	-	-
65	Do	-	do	8	-	-	-	-	-
66	Do	-	do	8	-	-	-	-	-
67	Do	-	do	8	-	-	-	-	-
68	Do	-	do	8	-	-	-	-	-
69	Do	-	do	8	-	-	-	-	-
70	Do	-	do	8	-	-	-	-	-
71	Do	Harr	1938	8	44	8	30-44	Sand and/or gravel	Pleiatocene
72	Do	do	do	8	36	8	26-36	do	do
73	Do	do	do	8	30(?)	8	-	do	do
74	Do	do	do	8	100	-	-	do	Patuxent
75	Do	do	do	8	-	-	-	-	-
76	Do	do	do	8	132	-	-	Sand and/or gravel	Patuxent
77	Do	do	do	8	180	-	-	Hard rock	Pre-Cambrian
78	Do	-	1898	8	1000	6	-	do	do
79	Do	-	-	8	72	-	-	Sand and/or gravel	Patuxent(?)

Continued

Water level (feet below land surface)			Pumping equipment	Depth of pump below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Pumping	Static	Date			Gallons a minute	Date				
-	-	-	N	-	-	-	-	N	-	Well covered.
-	-	-	N	-	-	-	-	N	-	Well covered; exact location unknown.
-	-	-	N	-	-	-	-	N	-	Do.
-	[a]14	-	N	-	50	-	-	N	-	Do.
-	7.00	May 29, 1944	I	20	90	-	-	I	72	See table of analyaea.
-	-	-	N	-	-	-	-	N	-	Well capped and covered.
-	-	-	N	30	-	-	-	N	-	Do.
-	-	-	N	-	0	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	0	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Well covered; exact location unknown.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Owner's well 1. Caaing removed.
-	8.25	May 29, 1944	N	-	-	-	-	N	-	Owner's well 2. Low yield reported.
-	[a]6	1944	I	27	15	1944	-	I	60	10-foot acreen in well. See table of analyaea.
-	-	-	N	-	-	-	-	N	-	Teat well. Caaing removed.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	A	160	60	May 29, 1944	-	I	-	Last meaaured depth 600 feet. See table of analyaes.
-	-	-	N	-	-	-	-	N	-	Well covered; exact location unknown. Water reported salty.

TABLE 15—

Location number	Owner or name	Driller	Date completed	Approximate altitude (feet)	Depth (feet)	Casing diameter (inches)	Depth of screen below land surface (feet)	Principal water-bearing formation	
								Character of material	Geologic age
2S1E-80	Bethlehem Steel Co. Baltimore Yard	-	-	5	72	2½	-	Sand and/or gravel	Patuxent(?)
81	Marble Works	-	Before 1896	10	60	2½	-	do	Pleistocene(?)
82	Do	-	do	10	200	6	-	Hard rock	Pre-Cambrian
83	Cavalier Shoe Polish Co.	Downin	1903	10	114	6	-	Sand and/or gravel	Patuxent
84	Do	do	1904	10	100	8	-	do	do
85	Jones Paper Mill	-	Before 1896	20	402	-	-	Hard rock	Pre-Cambrian
86	-	-	-	10	157	-	-	Sand and/or gravel	Patuxent
2S2E-1	Procter and Gamble Mfg. Co.	Layne-Atlantic	1938	10	110(?)	15	-	do	do
2	J. S. Young Co.	-	1896	10	174	-	-	do	do
3	Do	-	-	10	170	-	-	do	do
4	Do	-	-	10	118	-	-	do	do
5	Do	-	-	10	114	2	-	do	do
6	American Sugar Refining Co.	-	1920	10	212	-	-	Hard rock	Pre-Cambrian
7	Booth Packing Co.	-	1884	5	94	12-6	-	Sand and/or gravel	Patuxent
8	Do	Miller	Before 1918	5	96	10-6	-	do	do
9	Do	-	Before 1896	5	94	10-6	-	do	do
10	National Can Corp.	-	Before 1920	5	-	-	-	-	-
11	Do	-	1884	5	142	3	-	Sand and/or gravel	Patuxent
12	City of Baltimore Public well	-	Before 1896	10	-	-	-	-	-
13	Do	-	do	10	-	-	-	-	-
14	Procter and Gamble Mfg. Co.	-	1859	20	128	8	-	Sand and/or gravel	Patuxent
15	Do	-	1901	5	130	4-2	-	do	do
16	Miller Bros. & Co.	Miller	1905	10	98	6	-	do	do
17	Winebrenner Bros.	-	Before 1896	5	127	4	-	do	do
18	Farren & Co.	Claggett & O'Donovan	1895	5	116	-	-	do	do
19	Iron Works	-	Before 1896	10	-	-	-	-	-
20	Premium Bag Co.	-	Before 1918	10	106	4½	-	Sand and/or gravel	Patuxent

Continued

Water level (feet below land surface)			Pumping equipment	Depth of pump below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Pumping	Static	Date			Gallons a minute	Date				
-	-	-	N	-	-	-	-	N	-	Well covered; exact location unknown.
-	-	-	N	-	-	-	-	N	-	Exact location unknown. Water reported brackish.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	60	-	-	N	-	Well covered; exact location unknown.
-	[a]10	-	N	-	26	-	-	N	-	Do.
-	[a]70	-	N	-	75	-	-	N	-	Exact location unknown.
-	-	-	N	-	-	-	-	N	-	Well covered; exact location unknown. Hard rock at 162 feet.
-	-	-	I	80(?)	300	June 3, 1942	-	I	-	Owner's well 1. See tables of well logs and analyses.
-	-	-	N	-	24	-	-	N	-	Owner's well 7. Well covered. See table of analyses.
-	-	-	N	-	90	-	-	N	-	Owner's well 4. Well covered. See table of analyses.
-	-	-	N	-	-	-	-	N	-	Owner's well 5. Well covered. See table of analyses.
-	[a]2	-	N	-	20	-	-	N	-	Owner's well 6. Well covered. See table of analyses.
-	-	-	N	-	-	-	-	N	-	Test well; exact location unknown. See table of well logs.
-	[a]12	-	N	-	1,000	-	-	N	-	Well covered. Water reported salty and high in iron.
-	[a]18	-	N	-	1	-	-	N	-	Well covered; exact location unknown.
-	[a]4	-	N	-	200	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	[a]4	-	N	-	200	-	-	N	-	Water reported brackish at 40-45 feet. See table of well logs.
-	-	-	N	-	-	-	-	N	-	Exact location unknown.
-	-	-	N	-	-	-	-	N	-	Do.
-	[a]18	-	N	-	-	-	-	N	-	Well covered; exact location unknown.
-	[a]15	-	N	-	30	-	-	N	-	Do.
-	[a]25	-	N	-	35	-	-	N	-	Do.
-	[a]1	-	N	-	50	-	-	N	-	Exact location unknown. Hard rock at 127 feet.
-	[a]23	-	N	-	40	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	[a]16	-	N	-	50	-	-	N	-	Well covered; exact location unknown.

TABLE 15—

Location number	Owner or name	Driller	Date completed	Approximate altitude (feet)	Depth (feet)	Casing diameter (inches)	Depth of screen below land surface (feet)	Principal water-bearing formation: Character of material	Principal water-bearing formation: Geologic age
2S2E-21	Arundel-Brooks Concrete Corp.	-	Before 1918	5	317	8	-	Sand and gravel	Patuxent and/o Pre-Cambrian
22	Do	-	Before 1896	5	157	-	-	do	Patuxent
23	-	-	do	10	-	-	-	-	-
24	Arundel-Brooks Concrete Corp.	-	-	10	145	-	-	Sand and/or gravel	Patuxent
25	Do	-	-	10	145	-	-	do	do
26	Do	-	-	10	145	-	-	do	do
27	Do	-	-	10	145	-	-	do	do
28	Do	-	-	10	165	-	-	do	do
29	Do	-	-	10	165	-	-	do	do
30	Do	-	-	10	165	-	-	do	do
31	Do	-	-	10	165	-	-	do	do
32	Do	-	-	10	165	-	-	do	do
33	American Can Co.	-	Before 1918	5	120	8	-	do	do
34	Do	-	do	5	50	12	-	do	Pleistocene
35	Do	-	do	5	50	12	-	do	do
36	Do	-	do	5	60	12	-	do	do
37	Do	-	do	5	60	12	-	do	do
38	Southern Lacquer Co.	Baltimore Artesian Well Co.	1904	10	99	3	-	Gravel	Patuxent
39	Procter and Gamble Mfg. Co.	-	1897	10	110	-	-	Sand and/or gravel	do
40	H. J. McGrath Co.	-	1884	5	100	8	-	do	do
41	Do	-	Before 1896	5	225	4	-	Hard rock	Pre-Cambrian
42	Do	-	do	5	120	6	-	Sand and/or gravel	Patuxent
43	Safe Deposit and Trust Co.	O'Donovan	1883	5	100	8	-	do	do
44	Do	-	1889	5	100	-	-	do	do
45	Do	-	do	5	200(?)	6	-	Hard rock	Pre-Cambrian
46	Do	-	do	5	300(?)	6	-	do	do
47	Edw. Renneburg & Sons Co.	-	-	5	-	-	-	-	-
48	Do	-	Before 1896	5	123	6	-	Sand and/or gravel	Patuxent
49	Davidson & Co.	-	do	5	-	8	-	-	-
50	Baltimore & Ohio Railroad	Schultz	-	20	165	-	-	Sand and/or gravel	Patuxent
51	Procter and Gamble Mfg. Co.	-	1891	10	90	-	-	do	do
-	Schall Packing Co.	-	-	-	-	-	-	-	-

Continued

Water level (feet below land surface)			Pumping equipment	Depth of pump below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Pumping	Static	Date			Gallons a minute	Date				
-	[a]15	-	N	-	300	-	-	N	-	Well covered; exact location unknown. See table of well logs. Water reported brackish at 42-47 feet.
-	[a]15	-	N	-	300	-	-	N	-	Well covered; exact location unknown.
-	-	-	N	-	-	-	-	N	-	Do.
-	[a]20	-	N	-	-	-	-	N	-	Do.
-	[a]20	-	N	-	-	-	-	N	-	Do.
-	[a]20	-	N	-	-	-	-	N	-	Do.
-	[a]20	-	N	-	-	-	-	N	-	Do.
-	[a]20	-	N	-	-	-	-	N	-	Do.
-	[a]20	-	N	-	-	-	-	N	-	Do.
-	[a]20	-	N	-	-	-	-	N	-	Do.
-	[a]20	-	N	-	-	-	-	N	-	Do.
-	[a]20	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	30	-	-	N	-	Do.
-	-	-	N	-	30	-	-	N	-	Do.
-	-	-	N	-	60	-	-	N	-	Do.
-	-	-	N	-	60	-	-	N	-	Do.
-	[a]8	-	N	-	100	-	-	N	-	Well covered; exact location unknown. See table of well logs. Water reported of poor quality.
-	-	-	N	-	30	-	-	N	-	Well covered; exact location unknown.
-	[a]20	-	N	-	-	-	-	N	-	Well covered; exact location unknown. Ample supply reported. Water reported salty.
-	[a]6	-	N	-	-	-	-	N	-	Well covered; exact location unknown. Ample supply reported.
-	-	-	N	-	40	-	-	N	-	Well covered; exact location unknown.
-	[a]10	-	N	-	100	-	-	N	-	Do.
-	[a]10	-	N	-	100	-	-	N	-	Do.
-	-	-	N	-	100	-	-	N	-	Do.
-	-	-	N	-	100	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	[a]6	-	N	-	1,000 150	1910 -	-	N	-	Water reported high in iron.
-	[a]3	Before 1896	N	-	-	-	-	N	-	Exact location unknown. Water reported unfit for use.
-	-	-	-	-	-	-	-	N	-	
-	-	-	-	-	20	-	-	N	-	Well covered; exact location unknown.
-	-	-	-	-	-	-	-	N	-	Exact location unknown.

TABLE 15—

Location number	Owner or name	Driller	Date com-pleted	Approximate altitude (feet)	Depth (feet)	Casing diameter (inches)	Depth of screen below land surface (feet)	Principal water-bearing formation: Character of material	Principal water-bearing formation: Geologic age
2S3E-1	Gunther Brewing Co.	-	-	55	250 ±	12	-	Sand and/or gravel	Patuxent
2	Do	-	-	50	-	8	-	-	-
3	Do	-	-	55	-	12	-	-	-
4	Do	-	-	70	-	12	-	-	-
5	Do	-	-	50	-	8	-	-	-
6	National Brewing Co.	-	-	77	430	8	None	Hard rock	Pre-Cambrian
7	Do	-	1887	85	330	10	do	do	do
8	Do	-	1891	77	230	6	200-210	Sand and/or gravel	Patuxent
9	J. S. Young Co.	-	-	13	137	-	-	do	do
10	Do	-	-	10	-	-	-	-	-
11	Do	-	-	10	160	8	-	Sand and/or gravel	Patuxent
12	W. H. Whiting Forging Co.	-	-	10	235	8	-	do	do
13	American Smelting & Refining Co.	-	1905	10	235	8	-	do	do
14	Do	-	1902	10	215	8	-	do	do
15	Do	-	-	15	-	12	-	-	-
16	Do	-	-	15	129	10	-	Sand and/or gravel	Patuxent
17	Do	Harris-Harmon	1941	15	218	12	-	Sand and gravel	do
18	Do	-	-	15	-	8	-	-	-
19	Do	-	-	15	-	8	-	-	-
20	Do	-	-	20	-	-	-	-	-
21	Do	-	-	20	-	12	-	-	-
22	Do	-	-	20	-	12	-	-	-
23	Do	-	-	20	-	-	-	-	-
24	Do	-	-	20	-	12	-	-	-
25	Do	-	-	25	-	12	-	-	-
26	Do	Shannahan	1905	20	240	8	-	Sand and/or gravel	Patuxent
27	Waller Oil Co.	-	-	10	160	-	-	do	do
28	Do	-	-	10	87	4	-	do	do
29	Do	-	-	10	90	4	-	do	do
30	Do	-	Before 1896	5	90	12	-	do	do
31	Do	-	Before 1918	5	190	10	-	do	do
32	W. H. Whiting Forging Co.	-	-	10	-	3	-	-	-

Continued

Water level (feet below land surface)			Pumping equipment	Depth of pump below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Pumping	Static	Date			Gallons a minute	Date				
-	a70	1933	A	-	-	-	-	N	-	Owner's well 1. Well covered. See table of analyses.
-	-	-	A	-	-	-	-	N	-	Owner's well 2. See table of analyses.
-	-	-	N	-	-	-	-	N	-	Well covered.
-	-	-	N	-	-	-	-	N	-	Owner's well 4.
-	-	-	A	-	-	-	-	N	-	Owner's well 5. See table of analyses.
-	a132	Oct. 10, 1940	A	250	40	1943	-	I	-	Owner's well 1. Hard rock at 230 feet. See table of analyses.
-	a75	-	A	-	50	do	-	I	-	Owner's well 2. See table of analyses.
-	a109	Oct. 10, 1940	I	-	50	do	-	I	-	Owner's well 3. See table of analyses.
-	a35	-	N	-	35	-	-	N	-	Owner's well 1. See table of analyses.
-	-	-	N	-	20	-	-	N	-	Owner's well 2. See table of analyses.
-	34.14	Apr. 20, 1945	N	-	90	1941	-	N	-	Owner's well 3. Original depth 1,000 feet. See table of analyses.
-	-	-	N	-	-	-	-	N	-	Well covered. Ample supply reported.
-	a42	-	N	-	100	-	-	N	-	Well capped.
-	a52	-	N	-	100	-	-	N	-	Well covered. Ground around well caved in.
-	-	-	N	-	-	-	-	N	-	Water reported salty.
-	-	-	N	-	120	-	-	N	-	Well covered.
-	-	-	N	-	-	-	-	N	-	Casing filled with sand. See tables of well logs and analyses.
-	-	-	N	-	-	-	-	N	-	Casing filled at surface.
-	-	-	N	-	-	-	-	N	-	Casing capped with concrete.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Well capped.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Well covered; exact location unknown.
-	-	-	N	-	-	-	-	N	-	Casing filled at surface.
-	-	-	N	-	-	-	-	N	-	Well covered.
-	a50	-	N	-	180	-	-	N	-	Well covered; exact location unknown.
-	-	-	N	-	-	-	-	N	-	Do.
-	a16	-	N	-	20	-	-	N	-	Do.
-	a16	-	N	-	20	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Well covered.

TABLE 15—

Location number	Owner or name	Driller	Date completed	Approximate altitude (feet)	Depth (feet)	Casing diameter (inches)	Depth of screen below land surface (feet)	Principal water-bearing formation: Character of material	Principal water-bearing formation: Geologic age
2S3E-33	American Smelting & Refining Co.	Shannahan	1903	10	225	6	-	Sand	Patuxent
34	Canton Lumber Co.	-	1911	10	250	10	-	do	do
35	Do	-	1886	10	148	1½	-	do	do
36	Crown Cork & Seal Co.	-	Before 1913	40	187	8	-	do	do
37	Do	-	-	40	172	8	-	do	do
38	Do	-	-	40	157	6	-	do	do
39	Pennaylvania Railroad	Shannahan	1876	5	183	8	-	do	do
40	Do	Downin	-	5	215	8	-	do	do
41	Do	-	Before 1896	15	198	8	-	Gravel	do
42	Do	-	-	15	197	8	-	do	do
43	Owens-Illinois Can Co.	-	Before 1896	5	93	9	-	Sand and/or gravel	do
44	Do	-	do	5	112	10	-	do	do
45	Do	-	Before 1903	5	90	6	-	do	do
46	Do	-	do	5	118	6	-	do	do
47	Do	-	Before 1896	5	138	6	-	do	do
48	Standard Oil Co.	-	do	20	165	-	-	do	do
49	Do	-	do	20	114	8	-	do	do
50	Do	-	Before 1896	20	50	-	-	Sand and/or gravel	Patapaco(?)
51	Do	Shannahan	1906	20	214	-	-	do	Patuxent
52	Do	-	Before 1896	20	210	-	-	do	do
53	Do	-	do	20	185	-	-	do	do
54	Do	-	do	20	125	-	-	do	do
55	Do	-	do	35	130	20	-	do	do
56	Do	-	do	20	195	12	-	do	do
57	Do	-	Before 1918	20	184	13	-	do	do
58	Do	Shannahan	1909	40	184	10	141-147 170-180	do	do
59	Do	-	Before 1918	40	185	10	-	do	do

Continued

Water level (feet below land surface)			Pumping equipment	Depth of pump below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Pumping	Static	Date			Gallons a minute	Date				
-	a50	-	N	-	45	-	-	N	-	Well covered; exact location unknown.
-	-	-	N	-	-	-	-	N	-	Water reported salty in 1911.
-	-	-	N	-	20	-	-	N	-	Well covered.
-	a45	-	N	-	80	-	-	N	-	Well covered. See table of analyses.
-	a45	-	N	-	92	-	-	N	-	Well covered.
-	a20	-	N	-	27	-	-	N	-	Do.
-	a30	-	N	-	-	-	-	N	-	Well covered; exact location unknown. Water level reported originally 2 feet above land surface.
-	a20	-	N	-	130	-	-	N	-	Well covered; exact location unknown.
-	-	-	N	-	100	Before 1896	-	N	-	Well covered; exact location unknown. See table of well logs.
-	a50	-	N	-	125	-	-	N	-	Do.
-	-	-	N	-	20	Before 1896	-	N	-	Well covered; exact location unknown.
-	-	-	N	-	-	-	-	N	-	Well covered; exact location unknown. Ample supply reported.
-	-	-	N	-	-	-	-	N	-	Well covered; exact location unknown. Ample supply reported before 1903.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Well covered; exact location unknown. Ample supply reported before 1896.
-	-	-	N	-	45	Before 1896	-	N	-	Well covered; exact location unknown.
-	-	-	N	-	75	do	-	N	-	Do.
-	-	-	N	-	10	Before 1896	-	N	-	Do.
-	a36	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	80	Before 1896	-	N	-	Do.
-	-	-	N	-	80	do	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Well covered; exact location unknown. Water reported of poor quality in 1896.
-	a40	Before 1896	N	-	400	Before 1896	-	N	-	Well covered; exact location unknown.
-	a20	do	N	-	550	do	-	N	-	Do.
-	-	-	N	-	200	Before 1918	-	N	-	Well covered; exact location unknown. Water reported highly acidic.
-	a54	-	N	-	175	do	-	N	-	Well covered. Reported to have pumped oil-water emulsion immediately after drilling.
-	-	-	N	-	75	do	-	N	-	Well covered. Water reported to be acidic.

TABLE 15—

Location number	Owner or name	Driller	Date completed	Approximate altitude (feet)	Depth (feet)	Casing diameter (inches)	Depth of screen below land surface (feet)	Principal water-bearing formation: Character of material	Principal water-bearing formation: Geologic age
2S3E-60	Standard Oil Co.	-	Before 1905	40	190	8	-	Sand and/or gravel	Patuxent
61	Do	Shannahan	1907	40	200	6	-	Sand and gravel	do
62	Do	do	do	40	213	10-4¼	-	Sand and/or gravel	do
63	Do	do	do	40	200	6	-	do	do
64	Do	Layne-Atlantic	1928	60	224	18	-	Sand	do
65	W. H. Whiting Forgiog Co.	-	-	10	235	3	-	Sand and gravel	do
66	American Smelting & Refining Co.	-	-	25	196	4¼-3	-	Sand and/or gravel	do
67	Do	Shannahan	1905	25	210	8	-	do	do
68	Griffith & Boyd Co.	-	-	10	190	10	-	do	do
69	Do	-	-	10	90	12	-	do	Patapaco
70	Standard Oil Co.	-	Before 1896	20	50	-	-	do	do
71	Do	-	do	20	50	-	-	do	do
72	Do	-	do	20	50	-	-	do	do
73	Do	-	do	20	50	-	-	do	do
74	Do	-	do	20	50	-	-	do	do
75	Do	Shannahan	Before 1920	35	-	-	-	do	Patuxent
76	Do	do	do	40	-	-	-	do	do
77	Do	do	do	40	-	-	-	do	do
78	Do	do	do	40	-	-	-	do	do
79	Crown Cork & Seal Co.	do	1915	30	-	-	-	-	-
80	Standard Oil Co.	-	Before 1896	20	125	-	-	Sand and/or gravel	Patuxent
81	Do	-	do	20	125	-	-	do	do
82	-	-	Before 1918	20	212	-	-	do	do
83	-	-	do	20	50	-	-	do	Patapaco(?)
84	-	-	do	20	50	-	-	do	do
85	-	-	do	20	50	-	-	do	do
86	-	-	do	20	50	-	-	do	do
87	-	-	do	20	50	-	-	do	do
88	-	-	do	20	50	-	-	do	do
89	-	-	do	20	114	8	-	do	Patuxent
90	American Smelting & Refining Co.	Shannahan	1905	20	240	8	-	do	do
91	Do	do	1903	20	225	8	-	do	do
92	Do	do	do	20	225	6	-	do	do
93	Monumental Diatillera, Ioc.	-	Before 1896	-	190	-	-	do	do
94	Do	-	do	-	170	-	-	do	do
-	-	-	Before 1918	-	223	8	-	do	do

Continued

Water level (feet below land surface)			Pumping equipment	Depth of pump below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Pumping	Static	Date			Gallons a minute	Date				
-	-	-	N	-	25	Before 1918	-	N	-	Well covered.
-	-	-	N	-	-	-	-	N	-	Well covered; exact location unknown. See table of well logs.
-	-	-	N	-	120	1907	-	N	-	Well covered. Water reported very acidic.
-	-	-	N	-	-	-	-	N	-	Well covered; exact location unknown.
[a]110	[a]42	-	N	-	504	-	7.4	N	-	Well covered; exact location unknown. See table of well logs.
-	-	-	N	-	-	-	-	N	-	Well covered. Ample supply reported. See table of well logs.
-	[a]26	-	N	-	40	-	-	N	-	Well covered; exact location unknown.
-	[a]40	-	N	-	50	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	45	Before 1918	-	N	-	Do.
-	-	-	N	-	10	do	-	N	-	Do.
-	-	-	N	-	10	do	-	N	-	Do.
-	-	-	N	-	10	do	-	N	-	Do.
-	-	-	N	-	10	do	-	N	-	Do.
-	-	-	N	-	10	do	-	N	-	Do.
-	-	-	N	-	10	do	-	N	-	Do.
-	-	-	N	-	75	do	-	N	-	Do.
-	[a]50	Before 1918	N	-	235	do	-	N	-	Do.
-	[a]50	do	N	-	235	do	-	N	-	Do.
-	[a]50	do	N	-	45	do	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Exact location unknown. Ample supply reported.
-	[a]12	Before 1896	N	-	-	-	-	N	-	Do.
-	-	-	-	-	200	Before 1918	-	-	-	Exact location unknown.

TABLE 15—

Location number	Owner or name	Driller	Date completed	Approximate altitude (feet)	Depth (feet)	Casing diameter (inches)	Depth of screen below land surface (feet)	Principal water-bearing formation: Character of material	Principal water-bearing formation: Geologic age
2S3E-	Standard Oil Co.	-	Before 1918	40	200	8	-	Sand and/or gravel	Patuxent
2S4E-1	American Radiator & Standard Sanitary Corp.	Guarantee Water Engineering Co.	1926	31	176	20-16	163-176	Sand and gravel	do
2	Crown Cork & Seal Co.	Harris-Harmon	1942	60	180	-	-	Sand and/or gravel	do
3	St. Paul's Fifth Reformed Church Cemetery	-	-	80	100	-	-	do	Patapsco
4	Do	Harr	1943	80	135	6	-	do	do
5	Cambridge Iron & Metal Co.	Hoshall	1919	40	167	-	-	do	Patuxent
6	Do	do	do	40	210	8	-	do	do
7	Do	-	1916	40	160	6	-	do	do
8	Crown Cork & Seal Co.	-	-	40	121	8	-	do	do
9	Standard Oil Co.	Layne-New York	1926	40	224	12	-	Sand and gravel	do
10	Do	do	1929	35	229	18	-	Sand	do
11	Do	do	do	35	224	-	-	do	do
12	Do	Shannahan	1933	40	223	-	-	Sand and gravel	do
2S5E-1	Camp Holabird	Virginia Machinery & Well Co.	1930	30	290	12	-	Sand and/or gravel	do
2	Do	-	-	40	320	6	-	do	do
3	Do	-	-	30	300	6	-	do	do
4	Do	-	-	30	192	6	-	do	do
3S1E-1	Chesapeake Paperboard Co.	Layne-Atlantic	1942	20	150	10	-	do	do
2	Do	do	-	18	150	10	-	do	do
3	Do	do	1934	18	164	10	136-156	Sand and gravel	do
4	National Enameling & Stamping Co.	Downin	-	40	167	6	-	Sand	do
5	Kennedy Co.	Hoshall	1905	35	200(?)	6	-	Sand and/or gravel	do
6	National Enameling & Stamping Co.	Downin	1904	40	162	6	-	Sand	do
7	Western Maryland Railway Co.	-	Before 1896	20	160	10	-	Sand and/or gravel	do

Continued

Water level (feet below land surface)			Pumping equipment	Depth of pump below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Pumping	Static	Date			Gallons a minute	Date				
-	-	-	-	-	200	Before 1918	-	-	-	Well covered; exact location unknown. Water reported slightly acidic.
[a]132	[a]50	1926	I	-	240	1926	3.1	I	-	See tables of analyses and well logs.
[a]132	[a]100	Feb. 12, 1941			175	1943				
	71.73	Apr. 6, 1945								
160	-	Apr. 1, 1943	I	160	465	1942	-	I	-	See table of analyses.
-	-	-	H	-	-	-	-	D	-	Dug well. See table of analyses.
-	66.43	July 21, 1943	N	-	-	-	-	D	-	See table of analyses.
-	-	-	N	-	60	-	-	N	-	Well covered.
-	-	-	N	-	0	-	-	N	-	Do.
-	[a]52	-	N	-	-	-	-	N	-	Casing filled with debris.
-	[a]35	-	N	-	80	-	-	N	-	Well covered.
-	[a]50	-	-	-	306	-	-	N	-	Owner's well 1. Casing and screen partly decomposed by corrosion. See table of well logs.
-	[a]34	-	-	-	336	-	-	N	-	Owner's well 2. Casing and screen partly decomposed by corrosion. See table of well logs.
-	[a]42	-	N	-	504	-	-	N	-	Owner's well 3. Casing and screen partly decomposed by corrosion. See table of well logs.
-	[a]60	-	-	-	300	-	-	N	-	Owner's well 4. See table of well logs.
-	90.08	Aug. 3, 1945	I	-	260	1941	12.4	N	-	Owner's well 106. Water level measured periodically.
-	-	-	N	-	-	-	-	N	-	
-	-	-	N	-	0	-	-	N	-	
-	88.11	Aug. 3, 1944	N	-	-	-	-	N	-	Water level measured periodically.
-	36.07	Feb. 5, 1945	I	140(?)	111	February 1945	-	I	-	Owner's well 4. See table of analyses.
-	62.70	July 1, 1943	I	130	115	do	-	I	-	Owner's well 1. See table of analyses.
-	[a]5	July 1943	N	-	-	-	-	N	-	Well covered. See table of well logs.
-	[a]40	-	N	-	90	-	-	N	-	See table of well logs.
-	[a]6-8	-	N	-	-	-	-	N	-	Well covered; exact location unknown. Water reported salty.
-	[a]40	-	N	-	90	-	-	N	-	Well covered; exact location unknown.
-	[a]10	Before 1896	N	-	250	Before 1896	-	N	-	Do.

TABLE 15—

Location number	Owner or name	Driller	Date completed	Approximate altitude (feet)	Depth (feet)	Casing diameter (inches)	Depth of screen below land surface (feet)	Principal water-bearing formation: Character of material	Principal water-bearing formation: Geologic age
3S1E-8	Chesapeake Guano Co.	-	Before 1896	20	54	1½	-	Sand and/or gravel	Patuxent
9	Do	-	do	20	68	1½	-	do	do
10	Do	-	do	20	127	2	-	do	do
11	Do	-	do	20	117	2	-	do	do
12	Do	-	do	20	122	2	-	do	do
13	Consolidated Gas, Electric Light & Power Co.	-	1907(?)	20	150	6(?)	-	do	do
14	Baltimore & Ohio Railroad	Layne-New York	1926	43	185	10	-	do	do
15	Do	do	do	43	179	18-13	-	Sand and gravel	do
16	Do	do	1924	43	170	18-13	-	do	do
-	Miller Fertilizer Co.	-	-	32	-	-	-	-	-
3S2E-1	Fort McHenry	Davis	1814	34	145	144-72	-	Sand	Patuxent
2	Bethlehem Steel Co.	-	-	10	167	6	-	Sand and gravel	do
3	Do	-	1904	10	118	6	-	Sand and/or gravel	do
4	Warren Mfg. Co.	-	Before 1896	5	148	4	-	do	do
3S3E-1	Baugh Chemical Co.	Shannahan	1915	11	237	10-6	-	Sand and gravel	do
2	Do	do	1918	10	165	-	-	Sand and/or gravel	do
3	Pennsylvania Railroad	-	Before 1896	5	170	4(?)	-	do	do
4	Do	-	do	10	125	12	-	do	do
5	Do	-	do	10	170	3	-	do	do
6	Do	-	do	10	220	3	-	do	do
7	Do	-	do	10	80	3	-	do	do
8	American Agricultural Chemical Co.	-	do	5	220	6	-	do	do
9	Do	Rust	1897	5	230	8	-	do	do
10	Do	do	1902	5	240	6	-	do	do
11	Do	-	1896(?)	5	180(?)	4	-	do	do
12	Baugh Chemical Co.	Shannahan	1908	10	245	8	-	do	do

Continued

Water level (feet below land surface)			Pumping equipment	Depth of pump below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Pumping	Static	Date			Gallons a minute	Date				
-	-	-	N	-	150	Before 1896	-	N	-	Well covered; exact location unknown.
-	-	-	N	-	175	do	-	N	-	Well covered; exact location unknown. Water reported of poor quality.
-	-	-	N	-	100	do	-	N	-	Well covered; exact location unknown.
-	-	-	N	-	100	do	-	N	-	Do.
-	-	-	N	-	100	do	-	N	-	Do.
-	-	-	N	-	30	-	-	N	-	Well filled and covered; exact location unknown. Hard rock at 150 feet. Water reported salty.
-	-	-	N	-	150	-	-	N	-	Well filled and covered; exact location unknown.
-	[a]50	-	N	-	300	-	-	N	-	Well filled and covered; exact location unknown. See table of well logs.
-	-	-	N	-	168	-	-	N	-	Well covered; exact location unknown. See table of well logs.
-	-	-	-	-	-	-	-	N	-	Exact location unknown.
[a]33.5	[a]29.5	Before 1862	H	-	60	Before 1862	15	N	-	Dug well. See table of well logs.
-	-	-	N	-	100	-	-	N	-	Well covered; exact location unknown. Hard rock at 162 feet.
-	[a]20	-	N	-	-	-	-	N	-	Well covered; exact location unknown. Ample supply reported.
-	-	-	N	-	50	Before 1896	-	N	-	Well covered; exact location unknown.
-	[a]21.5	1915	A	190	220	May 3, 1943	-	I	-	Owner's well 4. See table of analyses.
-	70.5	February 1941	A	-	33	June 5, 1942	-	I	-	Owner's well 2. See table of analyses.
-	-	-	N	-	70	Before 1896	-	N	-	Well covered; exact location unknown.
-	-	-	N	-	-	-	-	N	-	Well covered; exact location unknown. Ample supply reported.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	[a]22	Before 1896	N	-	-	-	-	N	-	Do.
-	[a]20-30	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	132	-	-	N	-	Well covered; exact location unknown.
-	[a]18	-	N	-	200	-	-	N	-	Well covered; exact location unknown. Water reported very good originally, later high in salt and acid.

TABLE 15—

Location number	Owner or name	Driller	Date completed	Approximate altitude (feet)	Depth (feet)	Casing diameter (inches)	Depth of screen below land surface (feet)	Principal water-bearing formation: Character of material	Principal water-bearing formation: Geologic age
3S3E-13	Baugh Chemical Co.	-	Before 1896	10	175	-	-	Sand and/or gravel	Patuxent
14	Do	-	do	10	226	-	-	do	do
15	Do	-	do	10	130	1¼	-	Sand	do
16	Pennsylvania Railroad	-	do	10	200	10	-	do	do
17	American Agricultural Chemical Co.	-	do	10	140	2½-1¼	-	do	do
18	Do	-	do	10	140	2½-1¼	-	do	do
19	Do	-	do	10	140	2½-1¼	-	do	do
20	Baugh Chemical Co.	Dexter	1909	5	252	6	-	do	do
21	Pennsylvania Railroad	-	Before 1896	15	120	6	-	do	do
22	Do	-	do	15	216	8	-	do	do
23	Lazaretto Lighthouse	Robinson	1886	5	165(?)	1¼	-	do	do
24	Do	-	-	5	30	96	-	do	Pleistocene
25	Pennsylvania Railroad	-	Before 1896	15	129	10	-	do	Patuxent
26	City of Baltimore	Raymond Concrete Pile Co.	-	0	79	-	-	-	-
27	Do	do	-	0	78.5	-	-	-	-
28	Do	do	-	0	85	-	-	-	-
29	Do	do	-	0	89.5	-	-	-	-
30	Do	do	-	0	88.5	-	-	-	-
31	Do	do	-	0	87	-	-	-	-
32	Do	do	-	0	89.5	-	-	-	-
33	Do	do	-	0	84.5	-	-	-	-
34	Baugh Chemical Co.	Shannahan	1909	10	171	8	-	Sand	Patuxent
35	Pennsylvania Railroad	-	Before 1896	15	50	3	-	Sand and/or gravel	Patuxent(?)
3S4E-1	Camp Holabird	-	1936	17	312	12	-	Sand	Patuxent
2	Western Electric Co.	Layne-Atlantic	1930	10	294	12	234-249 264-294	Sand and gravel	do
3	Camp Holabird	Shannahan	1906	20	184	5	-	Gravel	do
4	Do	do	do	20	184	5	-	do	do
5	Do	do	do	20	184	5	-	do	do
6	Pennsylvania Railroad	-	Before 1896	5	165	16	-	Sand and/or gravel	do
7	Do	-	1907	5	296	8	-	do	do
8	Western Electric Co.	Shannahan	1905	5	150	2	-	do	do
9	Do	do	do	5	150	2	-	do	do
10	Do	do	do	5	109	6	-	do	do
11	Do	do	do	5	109	6	-	do	do
12	Do	do	do	5	109	6	-	do	do
13	Do	do	do	5	109	6	-	do	do
14	Do	do	do	5	109	6	-	do	do

Continued

Water level (feet below land surface)			Pumping equipment	Depth of pump below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Pumping	Static	Date			Gallons a minute	Date				
-	[a]3	Before 1896	N	-	-	-	-	N	-	Well covered; exact location unknown.
-	-	-	N	-	30	Before 1896	-	N	-	Do.
-	[a]2	Before 1896	N	-	30	do	-	N	-	Do.
-	[a]20	do	N	-	-	-	-	N	-	Well covered; exact location unknown. Ample supply reported.
-	[a]8	do	N	-	15	Before 1896	-	N	-	Well covered; exact location unknown.
-	[a]8	do	N	-	15	do	-	N	-	Do.
-	[a]8	do	N	-	15	do	-	N	-	Do.
-	[a]12	Before 1918	N	-	300	Before 1918	-	N	-	Well covered.
-	-	-	N	-	80	Before 1896	-	N	-	Well covered; exact location unknown.
-	[a]38	Before 1896	N	-	150	do	-	N	-	Do.
-	[a]18	Before 1918	N	-	5	Before 1918	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Dug well, covered; exact location unknown. Water reported very brackish and hard.
-	-	-	N	-	120	Before 1896	-	N	-	Well covered; exact location unknown.
-	-	-	N	-	-	-	-	N	-	Test boring. See table of well logs.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Well covered; exact location unknown. See table of well logs.
-	-	-	N	-	80	Before 1896	-	N	-	Well covered; exact location unknown.
-	-	-	I	-	450	-	19.6	N	59	See tables of analyses and well logs.
124.45	-	May 10, 1943	I	276	500	May 1943	-	I	-	Do.
-	-	-	N	-	167	1906(?)	-	N	-	Well capped.
-	-	-	N	-	167	do	-	N	-	Do.
-	-	-	N	-	167	do	-	N	-	Do.
-	[a]11	1907	N	-	150	-	-	N	-	Well covered; exact location unknown.
-	[a]16	do	N	-	70	-	-	N	-	Do.
-	[a]8-11	Before 1918	N	-	250	Before 1918	-	N	-	Do.
-	[a]8-11	do	N	-	300	do	-	N	-	Do.
-	[a]8	1905	N	-	100	1905	-	N	-	Do.
-	[a]8	do	N	-	100	do	-	N	-	Do.
-	[a]8	do	N	-	100	do	-	N	-	Do.
-	[a]8	do	N	-	100	do	-	N	-	Do.
-	[a]8	do	N	-	100	do	-	N	-	Do.

TABLE 15—

Location number	Owner or name	Driller	Date completed	Approximate altitude (feet)	Depth (feet)	Casing diameter (inches)	Depth of screen below land surface (feet)	Principal water-bearing formation: Character of material	Principal water-bearing formation: Geologic age
3S5E-1	Federal Yeast Corp.	Shannahan	1935	10	378	10	-	Sand and/or gravel	Patuxent
2	Do	do	do	10	378	10	-	do	do
3	Do	do	1915	10	131	6	-	do	Patapaco
4	Do	do	do	10	130	6	-	do	do
5	Do	do	do	10	130	6	-	do	do
6	Do	do	do	10	130	6	-	do	do
7	Do	do	do	10	130	8½	-	do	do
8	Do	do	1921	10	309	8	-	do	Patuxent
9	Do	do	-	10	130	8	-	do	Patapsco
10	Reid-Avery Co.	do	1942	15	280	8	-	do	Patuxent
11	Weatern Electric Co.	Layne-Atlantic	1930	10	301	18-12	238-261 281-301	Sand and gravel	do
12	Do	-	Before 1918	20	75	6	-	Sand and/or gravel	Patapaco
13	Ball Park	-	-	20	156	6	-	do	Patuxent
14	Chemical & Pigment Co.	-	-	15	-	-	-	-	-
15	Do	Shannahan	-	15	338	-	-	Sand and gravel	Patuxent
16	Do	do	1938	15	425	-	-	Sand and/or gravel	do
17	Do	do	1933	15	330	-	-	do	do
18	Do	do	1942	15	400	-	-	do	do
19	W. M. Gillmeyer	-	-	20	-	-	-	-	Patapaco(?)
20	Camp Holabird	-	Before 1918	10	180	-	-	Sand and/or gravel	Patuxent
21	Do	-	-	10	60	3	-	do	Patapsco
22	Do	-	Before 1918	10	150	2	-	Gravel	Patuxent
23	-	-	-	20	156	6	-	Sand and/or gravel	do
24	St. Helena Public Water Supply	-	Before 1914	20	100	6	-	do	do

Continued

Water level (feet below land surface)			Pumping equipment	Depth of pump below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Pumping	Static	Date			Gallons a minute	Date				
-	[a]53	1935	I	-	410	1943	-	I	56	Owner's well 1. See table of analyses. 48 feet of screen.
-	[a]53	do	I	-	410	do	-	I	-	Owner's well 2. See table of analyses. 48 feet of screen.
-	51.72	Apr. 20, 1945	N	-	-	-	-	N	-	Owner's well, Air Lift 1. Equipped with water-stage recorder from June 1, 1943 to July 31, 1943.
-	42.63	May 10, 1943	N	-	-	-	-	N	-	Owner's well, Air Lift 2.
-	[a]15	1915	N	-	-	-	-	N	-	Owner's well, Air Lift 3. Covered with cement.
-	41.86	May 10, 1943	A	-	-	-	-	I	57	Owner's well, Air Lift 4. See table of analyses.
56.48	-	Feb. 15, 1945								
-	38.08	May 10, 1943	A	-	-	-	-	I	57	Owner's well, Air Lift 5. See table of analyses.
-	75.60	do	A	-	-	-	-	I	57	Owner's well, Air Lift 6. Equipped with water-stage recorder Aug. 16, 1943 to Aug. 7, 1944. See table of analyses.
-	41.29	May 10, 1943	A	-	-	-	-	I	56.5	Owner's well, Air Lift 7. See table of analyses.
-	[a]70	-	I	166	90	1942	-	I	-	See table of analyses.
-	[a]27	1930	I	206	750	1943	-	I	59	Owner's well 1. Well repaired by cementing. See tables of well logs and analyses.
-	[a]90	1940								
223	-	May 10, 1943								
-	-	-	N	-	75	Before 1918	-	N	-	Well covered; exact location unknown.
-	-	-	N	-	50	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	600	-	-	N	-	See table of well logs.
-	[a]80	-	I	-	900	1945	-	I	-	Owner's well 2.
-	-	-	N	-	650	-	-	N	-	Owner's well 1.
-	-	-	I	-	500	1945	-	I	-	Owner's well 3. See table of analyses.
-	-	-	-	-	-	-	-	-	-	See table of analyses.
-	[a]20	Before 1918	N	-	60	Before 1918	-	N	-	Well covered; exact location unknown.
-	-	-	N	-	1½	-	-	N	-	Well covered; exact location unknown. Quality of water reported poor.
-	[a]3	Before 1918	N	-	35	Before 1918	-	N	-	Well covered; exact location unknown. See table of well logs.
-	-	-	-	-	50	-	-	-	-	Exact location unknown.
-	-	-	-	-	80	1914	-	N	-	Exact location unknown. See table of analyses.

TABLE 15—

Location number	Owner or name	Driller	Date completed	Approximate altitude (feet)	Depth (feet)	Casing diameter (inches)	Depth of screen below land surface (feet)	Principal water-bearing formation	
								Character of material	Geologic age
3S5E-25	Camp Holabird	-	Before 1918	10	180	-	-	Sand and/or gravel	Patuxent
26	Do	-	do	10	200	-	-	do	do
27	Do	-	do	10	200	-	-	do	do
28	Do	-	do	10	200	-	-	do	do
29	Do	-	do	10	150	2	-	Gravel	do
30	Federal Yeast Corp.	Shannahan	1945	15	390	16	-	Sand and gravel	do
31	Western Electric Co.	Layne-Atlantic	1946	5	436	20-12	261-286	do	do
4S1E-1	Arundel Corp.	-	1920(?)	5	234	8	-	Sand and/or gravel	Patuxent
2	U. S. Industrial Chemical Co.	-	-	-	-	-	-	-	-
3	Light Street Bridge	-	-	5	180	1¼	-	Sand and/or gravel	Patuxent
4	Read Drug & Chemical Co.	Harr	-	15	-	-	-	-	-
4S2E-1	Maryland Drydock Co.	Shannahan	1920	10	206	6	190-206	Sand and/or gravel	Patuxent
2	Do	Leatherbury	1926	10	262	6	-	do	do
3	Globe Shipbuilding & Dry Dock Co.	-	-	10	268	-	-	do	do
4	Weyerhaeuser Timber Co.	-	1918(?)	10	290	6	-	do	do
4S3E-1	F. S. Royster Guano Co.	Hoshall	1919	10	313	10-8	-	do	do
2	Bethlehem Fairfield Shipyards	Shannahan	1912	10	310	8-6	-	do	do
3	Do	Layne-Atlantic	1943	10	357	18-8	-	do	do
4	Do	do	do	10	234	18-8	200-230	do	do
5	Rasin-Monumental Co.	Sydnor Pump & Well Co.	1933	10	331	10	-	do	do
6	Do	-	Before 1908	10	175 ±	-	-	do	do
7	Do	Shannahan	1901	10	350	6-4	-	do	do
8	Arundel Shipbuilding	-	-	10	317	-	-	do	do
9	Bethlehem Fairfield Shipyards	Layne-Atlantic	1943	10	-	-	-	do	do
10	City of Baltimore	Raymond Concrete Pile Co.	-	0	20	-	-	-	-
11	Do	do	-	0	51	-	-	-	-
12	Do	do	-	0	76	-	-	-	-
13	Do	do	-	0	80	-	-	-	-

Continued

Water level (feet below land surface)			Pumping equipment	Depth of pump below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Pumping	Static	Date			Gallons a minute	Date				
-	[a]20	Before 1918	N	-	60	Before 1918	-	N	-	Well covered; exact location unknown.
-	[a]20	do	N	-	60	do	-	N	-	Do.
-	[a]20	do	N	-	60	do	-	N	-	Do.
-	[a]20	do	N	-	60	do	-	N	-	Do.
-	[a]3	do	N	-	35	do	-	N	-	Do.
-	-	-	I	-	-	-	-	I	-	See table of well logs.
[a]180	[a]70	July 5, 1946	I	-	750	1946	6.8	I	-	Drilled after June 1945; not shown on Plate 1. See table of well logs.
-	-	-	A	-	100±	1943	-	I	-	See table of analyses.
-	-	-	N	-	-	-	-	N	-	Well covered; exact location unknown.
-	-	-	N	-	-	-	-	N	-	Well covered; exact location unknown. Ample water supply reported; reported to have flowed.
-	-	-	N	-	-	-	-	N	-	
-	67.29	July 15, 1943	I	-	-	-	-	I	-	Owner's well 1. See table of analyses.
[a]56	[a]51	1940	I	72	90	1943	18	I	-	Owner's well 2. Pump capacity 150 gal. a min. See tables of analyses and well logs.
-	-	-	N	-	-	-	-	N	-	Well covered; exact location unknown. See table of analyses.
[a]90	-	1944	N	-	-	-	-	N	-	Water corrosive.
	58.85	Jan. 25, 1946								
-	-	-	R	140	20	1943	-	I	-	See table of analyses.
-	-	-	N	-	100	-	-	N	-	Well covered. See table of analyses.
-	-	-	I	160	400	1943	-	I	65	Owner's well 1. See tables of well logs and analyses.
[a]136	-	February 1943	I	140	325	do	-	I	-	Owner's well 2. See table of well logs.
	68.92	Aug. 30, 1943								
-	78.23	Aug. 30, 1943	N	-	-	-	-	N	-	Owner's well 3. Hard rock reported at 331 feet.
-	-	-	N	-	-	-	-	N	-	Owner's well 1; well covered. See table of analyses.
-	[a]8	1918	N	-	40	1918	-	N	-	Owner's well 2; well covered. See table of analyses.
-	-	-	N	-	-	-	-	N	-	Exact location unknown. See table of analyses.
-	62.71	Oct. 15, 1945	I	-	-	-	-	I	-	Owner's well New 2.
-	-	-	N	-	-	-	-	N	-	Test well. See table of well logs.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.

TABLE 15—

Location number	Owner or name	Driller	Date completed	Approximate altitude (feet)	Depth (feet)	Casing diameter (inches)	Depth of screen below land surface (feet)	Principal water-bearing formation	
								Character of material	Geologic age
4S3E-14	City of Baltimore	Raymond Concrete Pile Co.	-	0	81	-	-	-	-
-	Monumental Acid Works	-	-	-	155	4	-	Sand and/or gravel	Patuxent
5S2E-1	Brooklyne Chemical Works	Shannahan	1941	52	300 ±	10	-	do	do
2	Do	do	1943	60	327	10	210-230 246-252 321-325	Sand and gravel	do
3	City of Baltimore	-	Before 1918	40	440	-	-	Sand and/or gravel	do
4	Do	Harper	1907	40	416	8	-	do	do
5	Do	do	do	40	575	8	-	Hard rock	Pre-Cambrian
6	Do	do	do	40	130	8	-	Sand and/or gravel	Patuxent
7	Do	do	do	40	109	-	-	do	Patapaco
8	Do	do	do	40	170	8	-	Sand	Patuxent
9	Do	-	Before 1918	40	415	8	-	Sand and/or gravel	do
10	Do	-	Before 1896	40	80	8-3	-	do	Patapaco
11	Do	-	do	40	180	8-3	-	do	Patuxent
12	Do	-	do	40	-	8-3	-	-	-
13	Do	McGluckim & Cannon	-	40	42	-	-	Sand	Pleistocene
14	Do	J. B. McGluckim	1907	40	36	10	-	Sand and gravel	do
15	Do	-	Before 1896	40	180	8-3	-	Sand and/or gravel	Patuxent
16	Do	-	do	40	180	8-3	-	do	do
17	Do	-	do	40	180	8-3	-	do	do
18	Do	-	do	40	180	8-3	-	do	do
19	Do	-	do	40	180	8-3	-	do	do
20	U. S. Induatrial Chemical Co.	Shannahan	1946	12	262	14-10	222-262	do	do
5S3E-1	Do	do	1943	10	-	-	-	Sand and gravel	do
2	Do	do	1936	15	306	-	230-250	do	do

Continued

Water level (feet below land surface)			Pumping equipment	Depth of pump below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Pumping	Static	Date			Gallons a minute	Date				
-	-	-	N	-	-	-	-	N	-	Test well. See table of well logs.
-	[a]10-15	-	N	-	-	-	-	N	-	Location unknown.
-	82	July 31, 1943	I	180	-	-	-	I	58	See table of analyses.
[a]132	[a]93	1943	I	-	214	1943	5.5	I	-	See table of well logs.
-	-	-	N	-	0	1918	-	N	-	Well covered; exact location unknown.
-	-	-	N	-	300 +	-	-	N	-	Owner's well 1; well covered; exact location unknown. Hard rock at 400 feet.
-	-	-	N	-	100	-	-	N	-	Owner's well 3; well covered; exact location unknown. Hard rock at 373 feet.
-	-	-	N	-	200 +	-	-	N	-	Well covered; exact location unknown.
-	-	-	N	-	175	-	-	N	-	Owner's well 5. Well covered; exact location unknown.
-	-	-	N	-	120	-	-	N	-	Owner's well 2; well covered; exact location unknown. See table of well logs.
-	-	-	N	-	275	-	-	N	-	Well covered; exact location unknown. Hard rock at 440 feet.
-	-	-	N	-	-	-	-	N	-	Well covered; exact location unknown. Ample supply reported.
-	[a]25	1896	N	-	-	-	-	N	-	Do.
-	[a]25	do	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Well covered; exact location unknown. See table of well logs.
-	-	-	N	-	-	-	-	N	-	Do.
-	[a]25	1896	N	-	-	-	-	N	-	Well covered; exact location unknown. Ample supply reported.
-	[a]25	do	N	-	-	-	-	N	-	Do.
-	[a]25	do	N	-	-	-	-	N	-	Do.
-	[a]25	do	N	-	-	-	-	N	-	Do.
-	[a]25	do	N	-	-	-	-	N	-	Do.
124	92	1946	-	-	310	1946	9.7	I	-	See table of well logs. Drilled after June 1945; not shown on Plate 1.
169	-	Aug. 3, 1943	I	-	500	1943	-	I	59.5	See table of analyses.
[a]204	-	Dec. 12, 1936	I	-	595	1936	8.4	I	-	Owner's well 5023. See tables of well logs and analyses.
-	130	Aug. 3, 1943								

TABLE 15—

Location number	Owner or name	Driller	Date completed	Approximate altitude (feet)	Depth (feet)	Casing diameter (inches)	Depth of screen below land surface (feet)	Principal water-bearing formation: Character of material	Principal water-bearing formation: Geologic age
5S3E-3	U. S. Industrial Chemical Co.	-	-	15	-	-	-	-	-
4	Do	-	1915	15	258	-	-	Sand and/or gravel	Patuxent
5	Do	-	-	15	-	-	-	-	-
6	Do	-	-	15	178	-	-	Sand and/or gravel	Patuxent
7	Do	-	-	15	-	-	-	-	-
8	Do	-	-	15	-	-	-	-	-
9	Do	-	1915	15	260	-	-	Sand and/or gravel	Patuxent
10	Do	-	-	15	-	-	-	-	-
11	Do	-	-	20	-	-	-	-	-
12	Do	Shannahan	1938	20	282	-	259-282	Sand and gravel	Patuxent
13	Do	-	-	20	362	12	-	Sand and/or gravel	do
14	Do	-	1916	20	274	-	-	do	do
15	Do	-	do	20	200 ±	6-3	-	do	do
16	Do	-	do	20	347	-	-	do	do
17	The Texas Co.	Shannahan	1910	10	391.6	6	-	Gravel	do
18	Pan-American Refining Corp.	do	1922	10	394	6-4	-	Sand and/or gravel	do
19	Do	Hershel	1926	10	390 ±	12-4¼	-	do	do
20	Do	Shannahan	1933	10	390	12-4¼	-	do	do
21	Do	do	1939	10	396	16-7	-	Sand and gravel	do
22	Eastern Box Co.	do	1908	10	375	10-4	-	Sand and/or gravel	do
23	Do	do	1910	10	-	6	-	-	-
24	Do	do	1918	10	270 ±	4	-	Sand and/or gravel	Patuxent
25	Do	do	1905	10	200 ±	3	-	do	do
26	Do	do	do	10	200 ±	3	-	do	do
27	Richfield Oil Co.	-	-	10	250	-	-	do	do
28	Do	-	-	10	250	-	-	do	do
29	Do	-	-	10	-	-	-	-	-
30	Do	-	-	10	-	-	-	-	-
31	Do	-	-	10	-	-	-	-	-
32	Continental Oil Co.	Shannahan	1920	15	352	8-4¼	-	Gravel	Patuxent
33	Do	do	do	15	352	-	-	do	do
34	Do	do	do	15	350	-	-	Sand and/or gravel	do

Continued

Water level (feet below land surface)			Pumping equipment	Depth of pump below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Pumping	Static	Date			Gallons a minute	Date				
-	-	-	N	-	-	-	-	N	-	Owner's well 1694; well covered.
[a]90	[a]76	1935	N	-	70	1935	5.0	N	-	Owner's well 1696; well plugged.
-	-	-	N	-	-	-	-	N	-	Owner's well 1698.
[a]91	[a]77	1935	N	-	52	1935	3.5	N	-	Owner's well 1699; well plugged.
-	-	-	N	-	-	-	-	N	-	Owner's well 1700; well covered.
-	-	-	A	-	-	-	-	N	-	Owner's well 1697.
-	[a]69	1935	N	-	72	1935	-	N	-	Owner's well 1695.
173	-	1943	I	-	-	-	-	I	-	Owner's well 7277.
-	-	-	N	-	-	-	-	N	-	Owner's well 1705; well may be plugged.
[a]192 216.5	[a]112 -	1938 Aug. 3, 1943	I	210	500	1938	6.3	I	-	Owner's well 6842. Well gravel-walled by two gravel conductors. Well filled back to 282 feet in 1945. See tables of well logs and analyses.
[a]97.5	[a]86	1935	A	-	83	1935	7.3	N	-	Owner's well 1704.
-	[a]78	do	A	-	82	do	9	N	-	Owner's well 1703.
-	113.97	Jan. 25, 1946	A	-	83	do	-	N	-	Owner's well 1701.
-	99.96	do	A	-	27	1933	-	N	-	Owner's well 1702.
-	-	-	N	-	100	1930	-	N	-	Well covered. See tables of well logs and analyses.
-	-	-	N	-	-	-	-	N	-	Owner's well 1; well plugged.
-	-	-	N	-	-	-	-	N	-	Owner's well 2; well plugged.
-	[a]55	1934	N	-	225	-	-	N	-	Owner's well 3; well plugged.
[a]106	[a]88	July 1943	I	131	193	1939	9	I	-	Owner's well 4. See tables of well logs and analyses.
-	-	-	N	-	-	-	-	N	-	Owner's well 1; well covered. See table of analyses.
-	-	-	N	-	-	-	-	N	-	Owner's well 2; well covered.
-	-	-	N	-	-	-	-	N	-	Owner's well 3; well covered.
-	-	-	N	-	-	-	-	N	-	Owner's well 4; well covered.
-	-	-	N	-	-	-	-	N	-	Owner's well 5; well covered.
-	-	-	N	-	-	-	-	N	-	Well covered.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	[a]93	1941	I	-	375	-	-	N	-	Owner's well 2. See table of well logs.
[a]183.1	[a]43	do	I	-	375	-	2.6	N	-	Owner's well 1. See tables of well logs and analyses.
[a]191.8	[a]119.5	do	I	-	275	1941	3.8	N	-	Owner's well 3.

TABLE 15—

Location number	Owner or name	Driller	Date completed	Approximate altitude (feet)	Depth (feet)	Casing diameter (inches)	Depth of screen below land surface (feet)	Principal water-bearing formation	
								Character of material	Geologic age
5S3E-35	Continental Oil Co.	Shannahan	1936	15	342	16-4¼	258-273 316-342	Sand and gravel	Patuxent
36	Do	do	do	15	330	16-10	210-216 255-262 319-330	do	do
37	Do	do	1937	15	361	16-6	333-346 346-361	Sand and/or gravel	do
38	Do	do	do	15	358	16-6	264-274 328-358	do	do
39	Do	Pentz	1916	15	225	4	-	do	do
40	Do	do	do	15	225	4	-	do	do
41	Do	do	do	15	225	6	-	do	do
42	Do	do	1915	15	225	6	-	do	do
43	Do	do	do	15	225	6	-	do	do
44	Do	do	1917	15	225	6	-	do	do
45	City of Baltimore Sewage Disposal Plant	Shannahan	1908	10	381	8	-	Sand and gravel	do
46	U. S. Industrial Chemical Co.	do	1945	20	364	-	-	do	do
-	Baltimore Chrome Works	-	Before 1896	-	562	-	-	Sand and/or gravel	do
-	Do	-	do	-	155	4	-	do	do
6S2E-1	U. S. Industrial Chemical Co.	Shannahan	1942	15	245	10	-	Sand and gravel	do
2	Do	-	1925	15	367	-	-	Sand and/or gravel	do
3	Do	-	-	15	380	10-6	-	Sand	do
4	Do	Shannahan	1939	15	227	10	-	do	do
5	Do	-	-	15	295	8(?)	-	do	do

Continued

Water level (feet below land surface)			Pumping equipment	Depth of pump below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Pumping	Static	Date			Gallons a minute	Date				
[a]209	-	1939	N	-	410	1939	-	N	-	Well gravel-walled by two gravel conductors, 240 and 242 feet deep. See table of well logs.
-	-	-	I	-	570	1940	-	I	-	Owner's well 5. Well gravel-walled by two gravel conductors, 202 feet deep. See tables of analyses and well logs.
[a]201	[a]94	1937	I	-	390	1937	3.7	N	-	Owner's well 6. Well gravel-walled by two gravel conductors, 200 and 201.5 feet deep. See table of analyses.
- [a]219	[a]97 -	1937 1940	I	-	860	do	10.2	I	-	Owner's well 7. Well gravel-walled by two gravel conductors, 256 feet deep. See table of analyses.
-	[a]30	1918	N	-	80	-	-	N	-	Owner's well Old 1; well plugged.
-	[a]30	do	N	-	80	-	-	N	-	Owner's well Old 2; well plugged.
-	[a]30	do	N	-	80	-	-	N	-	Owner's well Old 3; well plugged.
-	[a]30	do	N	-	80	-	-	N	-	Owner's well Old 4; well plugged. See table of analyses.
-	[a]30	do	N	-	80	-	-	N	-	Owner's well Old 5; well plugged.
-	[a]30	do	N	-	80	-	-	N	-	Owner's well Old 6; well plugged.
-	-	-	N	-	75	-	-	N	-	Well covered; exact location unknown. See table of well logs.
-	-	-	-	-	-	-	-	I	-	Drilled after June 1945; not shown on Plate 1. See table of well logs.
-	-	-	N	-	0	-	-	N	-	Exact location unknown.
-	[a]2	-	N	-	15	-	-	N	-	Do.
- 96	[a]105 -	1941 Nov. 16, 1945	I	-	-	-	-	I	56.5	Owner's well 4241. See tables of analyses and well logs.
[a]178	[a]95	1943	N	-	100	1934	-	N	-	Owner's well 1468; well plugged. See table of analyses.
-	[a]95	1934	A	-	170	do	-	I	-	Owner's well 1323. See tables of well logs and analyses.
[a]177 137	[a]73 -	1939 Oct. 12, 1945	I	180	410	1939	3.9	I	57	Owner's well 3700. See tables of well logs and analyses.
-	[a]89	1941	N	-	173	1934	-	N	-	Owner's well 1324. See tables of well logs and analyses.

TABLE 15—

Location number	Owner or name	Driller	Date completed	Approximate altitude (feet)	Depth (feet)	Casing diameter (inches)	Depth of screen below land surface (feet)	Principal water-bearing formation: Character of material	Principal water-bearing formation: Geologic age
6S2E-6	U. S. Industrial Chemical Co.	-	1923	15	228	8(?)	-	Sand and gravel	Patuxent
7	Do	-	do	15	327	8(?)	-	Sand	do
8	Do	-	1925	15	374	12	-	Sand and/or gravel	do
9	Do	Shannahan	1940	25	293	10	-	do	do
10	Do	do	1935	22	144	12	118-138	Sand	Patapsco
11	Do	-	1917	15	301	-	273-297	Sand and/or gravel	Patuxent
12	Do	-	do	15	297	-	-	do	do
13	Do	-	do	15	297	-	269-293	do	do
14	Do	Shannahan	1920	15	431	-	-	do	do
15	Do	-	1917	15	342	-	-	do	do
16	Do	-	do	15	285	-	-	do	do
17	Do	-	do	15	283	-	-	do	do
18	Do	-	do	15	285	-	-	do	do
19	Do	-	do	15	341.5	-	298-322	Sand	do
20	Do	-	-	15	-	-	-	-	-
21	Do	-	-	15	-	-	-	-	-
22	Do	-	-	15	-	-	-	-	-
23	Do	-	-	15	-	-	-	-	-
24	Do	-	1917	15	302	-	279-295	Sand	Patuxent
25	Do	-	-	15	197	-	-	Sand and/or gravel	do
26	Do	-	-	15	-	-	-	-	-
27	Do	-	1917	10	306	-	290-306	Sand and/or gravel	Patuxent
28	Do	-	1919	10	309	-	289-305	Sand	do
29	Standard Wholesale Phosphate & Acid Works, Inc.	Shannahan	1921	30	330	10-4½	299-324	Sand and/or gravel	do

Continued

Water level (feet below land surface)			Pumping equipment	Depth of pump below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Pumping	Static	Date			Gallons a minute	Date				
-	[a]61	1934	A	-	250	1934	-	N	-	Owner's well 1325. See table of well logs.
-	73.46	Jan. 25, 1946								
-	[a]62	1923	A	-	95	do	-	I	57	Owner's well 1326. See tables of well logs and analyses.
-	[a]95	1934								
-	[a]95	1934	N	-	170	do	-	N	-	Owner's well 1469. Screen collapsed.
[a]176	[a]100	1941	I	220	650	1940	9	I	58	Owner's well 3929. See table of analyses.
124	-	May 4, 1945								
-	35.64	Sept. 9, 1944	A	-	150 ±	1943	-	I	-	Owner's well 2540. See tables of well logs and analyses.
-	[a]24	1935	N	-	201	1935	-	N	-	Owner's well 747; well plugged. See table of analyses.
-	[a]24	do	N	-	231	do	-	N	-	Owner's well 750; well plugged. See table of analyses.
-	[a]30.5	do	N	-	-	-	-	N	-	Owner's well 748; well plugged. See table of analyses.
-	-	-	N	-	-	-	-	N	-	Owner's well 1154; well covered. See table of well logs.
-	-	-	N	-	-	-	-	N	-	Owner's well 741; well covered.
-	-	-	N	-	-	-	-	N	-	Owner's well 739; well covered.
-	-	-	N	-	-	-	-	N	-	Owner's well 743; well covered.
-	-	-	N	-	-	-	-	N	-	Owner's well 742; well covered.
-	-	-	N	-	-	-	-	N	-	Owner's well 740; well covered. See table of well logs.
-	-	-	N	-	-	-	-	N	-	Well covered.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Owner's well 744; well covered.
-	[a]26	1917	N	-	180	1917	-	N	-	Owner's well 749; well covered. See table of well logs.
-	-	-	N	-	-	-	-	N	-	Owner's well 746; well covered.
-	-	-	N	-	-	-	-	N	-	Owner's well 745; well covered.
-	-	-	N	-	-	-	-	N	-	Owner's well 752.
-	-	-	N	-	250	1917	-	N	-	Owner's well 751. See table of well logs.
-	-	-	A	-	-	-	-	I	57	Owner's well 1. See table of analyses.

TABLE 15—

Location number	Owner or name	Driller	Date completed	Approximate altitude (feet)	Depth (feet)	Casing diameter (inches)	Depth of screen below land surface (feet)	Principal water-bearing formation: Character of material	Principal water-bearing formation: Geologic age
6S2E-30	Standard Wholesale Phosphate & Acid Works, Inc.	Shannahan	1925	30	286	10-6	-	Sand and/or gravel	Patuxent
31	Do	do	1929	30	344	12-4¼	293-348	Sand	do
32	Do	do	1941	30	335	10	-	Sand and gravel	do
33	American Oil Co.	-	-	10	100 ±	-	-	Sand and/or gravel	Patapaco
34	E.I. DuPont de Nemours Co.	-	1920	10	402	-	-	do	Patuxent
35	Standard Wholesale Phosphate & Acid Works, Inc.	-	1915	30	200	6	-	do	do
36	Baltimore & Ohio Railroad	-	1920	12	315	10	-	Sand	do
37	Standard Wholesale Phosphate & Acid Works, Inc.	-	Before 1920	10	172	-	-	Sand and/or gravel	do
38	Do	-	do	10	293	-	-	do	do
39	Baltimore & Ohio Railroad	Layne-Bowler	1921	12	240	10	-	do	do
40	E.I. DuPont de Nemours Co.	-	-	10	80	6	-	do	Patapaco
41	Do	-	-	10	230	4	-	do	Patuxent
42	Standard Wholesale Phosphate & Acid Works, Inc.	-	1916	30	200	6	-	do	do
43	Do	-	do	30	200	-	-	do	do
44	Bethlehem Fairfield Shipyards	Shannahan	1917	35	300	8	-	do	do
45	Do	do	do	35	300	8	-	do	do
46	Do	do	do	35	300	8	-	do	do
47	Do	do	do	35	300	8	-	do	do
48	Do	do	do	35	300	8	-	do	do
49	Do	do	do	35	300	8	-	do	do
50	Do	do	do	35	300	8	-	do	do
51	Do	do	do	35	300	8	-	do	do
52	Do	do	do	35	300	8	-	do	do
53	Do	do	do	35.	300	8	-	do	do
54	Do	do	do	35	300	8	-	do	do
55	Do	do	do	35	300	8	-	do	do
56	Do	Curtis Woodruff Co.	1916	35	100	6	-	do	Patapaco
57	Do	do	do	35	100	6	-	do	do
58	Do	do	do	35	100	6	-	do	do
59	Do	do	do	35	100	6	-	do	do
60	Do	-	1915	35	125	12	-	do	do
61	Do	-	do	35	125	12	-	do	do
62	Do	-	do	35	125	12	-	do	do

Continued

Water level (feet below land surface)			Pumping equipment	Depth of pump below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Pumping	Static	Date			Gallons a minute	Date				
-	-	-	A	-	60 ±	1941	-	I	-	Owner's well 2. See table of analyses.
[a]61	[a]48	1929	I	-	60 ±	do	4.6	I	58	Owner's well 3. See tables of analyses and well logs.
-	[a]107	1941	I	157	175 ±	1943	-	I	59	Owner's well 4. See tables of analyses and well logs.
164	-	Aug. 27, 1943								
-	-	-	N	-	-	-	-	N	-	Well covered. Quality reported poor.
-	-	-	N	-	-	-	-	N	-	Test well.
-	[a]2.5	1918	N	-	15	1918	-	N	-	Exact location unknown.
-	-	-	N	-	-	-	-	N	-	Well covered; exact location unknown. See table of well logs.
-	-	-	N	-	-	-	-	N	-	Well covered; exact location unknown. See table of analyses.
-	-		N	-	-	-	-	N	-	Do.
-	-	-	N	-	250	-	-	N	-	Well covered; exact location unknown.
-	[a]10	1896	N	-	-	-	-	N	-	Well covered; exact location unknown. Ample yield reported in 1896.
-	[a]10	do	N	-	-	-	-	N	-	Do.
-	[a]2.5	1918	N	-	15	1918	-	N	-	Exact location unknown.
-	[a]2.5	do	N	-	-	-	-	N	-	Do.
-	[a]30	do	N	-	300	1918	-	N	-	Well covered; exact location unknown.
-	[a]30	do	N	-	300	do	-	N	-	Do.
-	[a]30	do	N	-	300	do	-	N	-	Do.
-	[a]30	do	N	-	300	do	-	N	-	Do.
-	[a]30	do	N	-	300	do	-	N	-	Do.
-	[a]30	do	N	-	300	do	-	N	-	Do.
-	[a]30	do	N	-	300	do	-	N	-	Do.
-	[a]30	do	N	-	300	do	-	N	-	Do.
-	[a]30	do	N	-	300	do	-	N	-	Do.
-	[a]30	do	N	-	300	do	-	N	-	Do.
-	[a]30	do	N	-	300	do	-	N	-	Do.
-	[a]30	do	N	-	300	do	-	N	-	Do.
-	[a]30	do	N	-	125	do	-	N	-	Do.
-	[a]30	do	N	-	125	do	-	N	-	Do.
-	[a]30	do	N	-	125	do	-	N	-	Do.
-	[a]30	do	N	-	125	do	-	N	-	Do.
-	[a]17	do	N	-	250	do	-	N	-	Do.
-	[a]17	do	N	-	250	do	-	N	-	Do.
-	[a]17	do	N	-	250	do	-	N	-	Do.

TABLE 15—

Location number	Owner or name	Driller	Date completed	Approximate altitude (feet)	Depth (feet)	Casing diameter (inches)	Depth of screen below land surface (feet)	Principal water-bearing formation: Character of material	Principal water-bearing formation: Geologic age
6S3E-1	Davison Chemical Corp.	-	-	6	244	10-6	230-244	Sand	Patuxent
2	Do	Shannahan	-	10	460	8-6	448-460	Sand and gravel	do
3	Do	-	-	10	430	8-4½	415-430	Sand and/or gravel	do
4	Do	-	-	10	320	10-4½	-	Sand and gravel	do
5	Do	-	-	10	307	10-6	290-307	Sand	do
6	Do	-	-	10	316	-	-	do	do
7	Do	Shannahan	-	20	339	10-8	323-339	do	do
8	Do	Harris-Harmon	1940	20	310	-	-	do	do
9	Baltimore & Ohio Railroad	-	-	11	125	-	-	Sand and/or gravel	Patapsco
6S4E-1	U. S. Quarantine Station	-	-	10	125	6	-	do	do
-	Do	-	-	-	150	-	-	do	Patuxent
7S2E-1	A. Smith & Sons	-	-	10	24	-	-	do	Pleistocene
7S3E-1	Davison Chemical Corp.	Shannahan	-	10	166	-	-	do	Patuxent
2	Do	-	1915	130±	260	8-6	-	do	Patapsco
3	Do	Shannahan	1913	130±	244	-	233-244	Sand and gravel	do
4	Do	Hoshall	1919	30	175	6	-	Sand and/or gravel	Patuxent
7S5E-1	U. S. Navy Fort Armistead	-	1898	15-20	572	6	-	do	do
2	Davison Chemical Corp.	Shannahan	1909	-	240	-	-	do	do
3	Do	do	1901	20	148	10	-	do	Patapsco(?)
4	Do	do	1895	20	160	10	-	do	do
5	Hawkins Point	-	do	-	137	-	-	Sand	Patapsco
1S1W-1	Armour & Co.	Downin	-	45	178	6	-	Hard rock	Pre-Cambrian
2	E. H. Koester Bakery	Hoshall	1923	65	46	6	-	Sand and/or gravel	Patuxent
3	Consolidated Cold Storage, Inc.	Miller	-	30	304	8	-	Hard rock	Pre-Cambrian
4	Do	Downin	-	30	100	8-6	-	do	do
5	Do	-	-	30	-	-	-	-	-
6	Do	-	-	30	-	-	-	-	-
7	Do	-	-	30	-	-	-	-	-
8	Do	-	-	30	-	-	-	-	-
9	Do	-	-	30	-	-	-	-	-
10	Do	-	-	30	-	-	-	-	-
11	Do	-	-	30	-	-	-	-	-

Continued

Water level (feet below land surface)			Pumping equipment	Depth of pump below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Pumping	Static	Date			Gallons a minute	Date				
-	64.26	Aug. 13, 1943	N	-	30	1943	-	N	-	Owner's well 1; well plugged. See table of analyses.
-	-	-	N	-	-	-	-	N	-	Owner's well 2; well plugged. See table of well logs.
-	-	-	N	-	-	-	-	N	-	Owner's well 3; well plugged.
-	-	-	N	181.4	-	-	-	N	-	Owner's well 4; well plugged.
-	-	-	N	220	-	-	-	N	-	Owner's well 5; well plugged.
-	-	-	N	252	90	1942	-	N	-	Owner's well 6; well plugged. See tables of well logs and analyses.
[a]100	-	1938	I	-	134	1938	-	N	-	Owner's well 7. See tables of well logs and analyses.
-	90	Aug. 13, 1943								
107	81	Aug. 13, 1943	I	150±	500	1943	19.2	I	60	Owner's well 8. See tables of well logs and analyses.
-	-	-	N	-	-	-	-	N	-	Exact location unknown.
-	8	Nov. 9, 1943	I	20	65	1943	-	P	-	See table of analyses.
-	-	-	N	-	-	-	-	N	-	Well covered; exact location unknown.
-	-	-	R	-	-	-	-	I	-	
-	[a]100	-	N	-	-	-	-	N	58	Well plugged with cement in 1945. See table of analyses.
-	-	-	A	-	-	-	-	D	-	See table of analyses.
-	-	-	A	-	-	-	-	N	-	See table of well logs.
-	-	-	N	-	8	-	-	N	-	Exact location unknown. See table of analyses.
-	[a]34-38	-	N	-	50	-	-	N	-	Well covered.
-	[a]2	-	N	-	-	-	-	N	-	Well covered; exact location unknown.
-	[a]15	-	N	-	40	-	-	N	-	Do.
-	[a]20	-	N	-	60	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Well covered; exact location unknown. See table of well logs.
-	-	-	N	-	50	-	-	N	-	Well covered; exact location unknown.
-	-	-	N	-	5	-	-	N	-	Well covered.
-	[a]30	-	N	-	25	-	-	N	-	Well covered; exact location unknown.
-	[a]30	-	N	-	60	-	-	N	-	Well covered; exact location unknown. See table of well logs.
-	-	-	N	-	-	-	-	N	-	Well covered; exact location unknown.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do

TABLE 15—

Location number	Owner or name	Driller	Date completed	Approximate altitude (feet)	Depth (feet)	Casing diameter (inches)	Depth of screen below land surface (feet)	Principal water-bearing formation: Character of material	Principal water-bearing formation: Geologic age
1S1W-12	Consolidated Cold Storage, Inc.	-	-	30	-	-	-	-	-
13	Do	-	-	30	-	-	-	-	-
14	Do	-	-	30	-	-	-	-	-
15	Do	-	-	30	-	-	-	-	-
16	Do	-	-	30	-	-	-	-	-
17	Do	-	-	30	-	-	-	-	-
18	Do	-	-	30	-	-	-	-	-
19	Do	-	-	30	-	-	-	-	-
20	Do	-	-	30	-	-	-	-	-
21	Do	-	-	30	-	-	-	-	-
22	Do	-	-	30	-	-	-	-	-
23	Do	-	-	30	-	-	-	-	-
24	Do	-	-	30	-	-	-	-	-
25	Do	-	Before 1896	36	353	8-6	-	Hard rock	Pre-Cambrian
26	Swift & Co.	Brown	1909	40	105	6	-	do	do
27	Levy Hat Factory	Rust	1911	55	525	6	-	do	do
28	"Parking Lot"	Downin	-	37	85	6	-	do	do
29	Do	do	-	36	77	6	-	Sand	Patuxent
30	Do	do	-	36	90	6	-	do	do
31	Do	do	-	36	94	6	-	do	do
32	Walters Art Gallery	-	-	80	-	-	-	-	-
33	St. Alphonsus Church	Miller	1900	40	42	60	-	Gravel	Patuxent
34		Downin	-	70	105	-	-	Hard rock	Pre-Cambrian
1S2W-1	American Ice Co.	do	1911	132	242	6	-	do	do
2	Do	do	do	132	200	6	-	do	do
3	Do	do	-	75	1017	6	-	do	do
4	Do	Eastern Artesian Well Co.	1904	75	-	8	-	do	do
5	Baltimore Brewing Co.	Downin	-	100	312	-	-	do	do
6	Lipp Soap Works	-	Before 1896	80	200	-	-	do	do
7	Do	-	do	80	350	-	-	do	do
8	Ward Baking Co.	-	-	-	-	-	-	-	-
1S3W-1	Baltimore Butchers Abattoir	Hoshall	1929	100	503	6	-	Hard rock	Pre-Cambrian
2	Baltimore Paint & Color Works	-	-	-	-	-	-	-	-
3	Do	-	-	-	-	-	-	-	-

Continued

Water level (feet below land surface)			Pumping equipment	Depth of pump below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Pumping	Static	Date			Gallons a minute	Date				
-	-	-	N	-	-	-	-	N	-	Well covered; exact location unknown.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	100	-	-	N	-	Well plugged in 1909 or 1911. Well covered; exact location unknown.
-	-	-	N	-	11	-	-	N	-	Well covered.
-	23	1944	N	-	130	-	-	N	-	
-	-	-	N	-	-	-	-	N	-	Well covered; exact location unknown. See table of well logs.
-	-	-	N	-	4	-	-	N	-	Do.
-	-	-	N	-	4	-	-	N	-	Well covered; exact location unknown.
-	-	-	N	-	-	-	-	N	-	Well covered; exact location unknown. See table of well logs.
-	-	-	N	-	200	-	-	N	-	Well covered; exact location unknown.
-	[a]38	1918	-	-	55	1918	-	-	-	Dug well; exact location unknown.
-	-	-	N	-	-	-	-	N	-	Well covered; exact location unknown. See table of well logs.
-	[a]14	-	N	-	60	-	-	N	-	Well covered. Hard rock at 15 feet.
-	[a]15	-	N	-	40	-	-	N	-	Well covered. Hard rock at 20 feet.
-	-	-	N	-	20	-	-	N	-	Well covered. See table of well logs.
-	-	-	N	-	-	-	-	N	-	Well covered. Hard rock at 45 feet.
-	-	-	-	-	18	1918	-	N	-	Exact location unknown.
-	-	-	-	-	35	1896	-	N	-	Do.
-	-	-	-	-	35	do	-	N	-	Do.
-	-	-	-	-	-	-	-	-	-	Do.
-	-	-	-	-	14	-	-	N	-	Exact location unknown. Hard rock at 15 feet.
-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	

TABLE 15—

Location number	Owner or name	Driller	Date completed	Approximate altitude (feet)	Depth (feet)	Casing diameter (inches)	Depth of screen below land surface (feet)	Principal water-bearing formation: Character of material	Principal water-bearing formation: Geologic age
1S3W-4	Baltimore Paint & Color Works	-	-	-	-	-	-	-	-
5	Otterheimer Bros.	-	-	-	-	-	-	-	-
6	Superfine Ice Cream	-	-	-	-	-	-	-	-
7	Wilkens Hair Factory	Downin	1909	60	200	6	-	Hard rock	Pre-Cambrian
8	Do	do	do	60	206	6	-	do	do
9	Do	do	do	60	225	6	-	do	do
-	Sheep Butchers Abattoir	-	-	-	80	-	-	-	-
1S4W--	Montgomery Property	-	-	200	98	6	-	Hard rock	Pre-Cambrian
1S6W-1	James Cook	-	-	-	-	-	-	-	-
2S1W-1	Hilgartner Marble Co.	-	-	10	75 ±	8-6	-	Sand and/or gravel	Pleistocene(?)
2	Do	-	-	10	75 ±	8-6	-	do	do
3	Do	-	-	10	75 ±	8-6	-	do	do
4	Do	-	-	10	75 ±	8-6	-	do	do
5	Do	-	-	10	75 ±	8-6	-	do	do
6	Do	-	-	10	75 ±	8-6	-	do	do
7	Do	-	-	10	75 ±	8-6	-	do	do
8	Do	-	-	10	75 ±	8-6	-	do	do
9	Do	-	-	10	44	4	-	do	do
10	National Distillers Products Corp.	-	About 1900	10	55	144-120	-	do	do
11	Do	-	do	10	55	144-120	-	do	do
12	Baltimore Pearl Hominy Co.	Hoshall	1920	10	-	-	-	-	-
13	Do	do	do	10	-	-	-	-	-
14	Do	do	do	10	-	-	-	-	-
15	Do	do	do	10	-	-	-	-	-
16	Do	do	do	10	-	-	-	-	-
17	Do	do	do	10	-	-	-	-	-
18	Do	do	do	10	-	-	-	-	-
19	Do	do	do	10	-	-	-	-	-
20	Revere Copper & Brass, Inc.	do	1924	20	60 ±	-	-	Sand and/or gravel	Pleistocene(?)
21	Do	do	do	20	60 ±	-	-	do	do
22	Do	do	do	20	60 ±	-	-	do	do
23	Do	do	do	20	60 ±	-	-	do	do
24	National Distillers Products Corp.	Baltimore Artesian Well Co.	1904-1914	10	40	2½	-	do	do
25	Do	do	do	10	40	2½	-	do	do
26	Do	do	do	10	40	2½	-	do	do
27	Do	do	do	10	40	2½	-	do	do
28	Purex Products, Inc.	-	-	20	500	-	-	Hard rock	Pre-Cambrian
29	Maryland Chemical Co.	Hoshall	1919 ±	6	180	6	-	do	do
30	Cat's Paw Rubber Co.	Harr	1936	15	611	8	-	do	do
31	Hannis Dist. Co.	-	Before 1896	10	800	-	-	do	do

Continued

Water level (feet below land surface)			Pumping equipment	Depth of pump below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Pump-ing	Static	Date			Gallons a minute	Date				
-	-	-	-	-	-	-	-	N	-	
-	-	-	-	-	-	-	-	-	-	Exact location unknown.
-	-	-	-	-	-	-	-	-	-	Do.
-	-	-	-	-	35	1918	-	N	-	Do.
-	-	-	-	-	4	do	-	N	-	Do.
-	-	-	-	-	35	do	-	N	-	Do.
-	-	-	-	-	66	1896	-	N	-	Do.
-	-	-	-	-	3	1918	-	-	-	Do.
-	-	-	-	-	-	-	-	-	-	Do.
-	-	-	N	-	-	-	-	N	-	Well covered. Water reported brackish.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	I	-	-	-	-	I	-	Dug well. See table of analyses.
-	-	-	N	-	-	-	-	N	-	Dug well; covered and filled.
-	-	-	N	-	25	-	-	N	-	Well covered; exact location unknown.
-	-	-	N	-	25	-	-	N	-	Do.
-	-	-	N	-	25	-	-	N	-	Do.
-	-	-	N	-	25	-	-	N	-	Do.
-	-	-	N	-	25	-	-	N	-	Do.
-	-	-	N	-	25	-	-	N	-	Do.
-	-	-	N	-	25	-	-	N	-	Do.
-	-	-	N	-	25	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	[a]10	-	N	-	62	-	-	N	-	Well covered; exact location unknown. See table of well logs.
-	[a]10	-	N	-	62	-	-	N	-	Well covered; exact location unknown.
-	[a]10	-	N	-	62	-	-	N	-	Do.
-	[a]10	-	N	-	62	-	-	N	-	Do.
-	-	-	N	-	0	-	-	N	-	Well covered; exact location unknown. Hard rock at 30 feet.
-	-	-	N	-	20	-	-	N	-	Well covered. Hard rock at 18 feet. Quality of water reported poor.
-	-	-	N	-	6	1936	-	N	-	Exact location unknown.
-	-	-	N	-	20	1896	-	N	-	Do.

TABLE 15—

Location number	Owner or name	Driller	Date completed	Approximate altitude (feet)	Depth (feet)	Casing diameter (inches)	Depth of screen below land surface (feet)	Principal water-bearing formation: Character of material	Principal water-bearing formation: Geologic age
2S1W-32	Hannis Dist. Co.	-	Before 1896	10	42	12	-	Sand and/or gravel	Pleistocene
33	Do	-	do	10	42	12	-	do	do
34	Wm. Grecht Co.	-	Before 1918	10	33	-	-	do	do
2S2W-1	Baltimore Enamel & Novelty Co.	-	1917	10	100	6	-	Hard rock	Pre-Cambrian
2	Do	-	do	10	100	6	-	do	do
2S3W-1	Greenwald Abattoir	Downin	-	100	196	6	-	do	do
2	Do	do	-	100	-	-	-	-	-
3	Industrial School for Boys	Conlan	-	100	775	-	-	Hard rock	Pre-Cambrian
4	United Distilleries	-	1895	85	480	6	-	do	do
-	Lober	Downin	Before 1918	120	360	-	-	do	do
2S4W-1	St. Agnes School	-	Before 1896	140	800	-	-	do	do
2	St. Josephs College	-	1907	200	67	6	-	do	do
3	Chas. Wiskow	Hoshall	1911	200	254	6	-	do	do
4	Do	do	do	200	109	6	None	do	do
5	Victor G. Bloede Co.	Stothoff	1902	120	400	-	do	do	do
3S1W-1	Carr-Lowrey Glass Co.	-	-	15	206(?)	-	do	do	do
2	Do	Harr	Before 1927	15	400	8	do	do	do
3	Do	do	1918	15	500 ±	8	do	do	do
4	General Chemical Co.	-	1894	20	104	6	-	Sand and/or gravel	Patuxent
5	Consolidated Gas, Electric Light & Power Co.	-	-	10	60	6	-	Sand	do
6	Westport Paving Brick Co.	-	-	15	19	150	-	Sand and/or gravel	do
7	Consolidated Gas, Electric Light & Power Co.	Baltimore Artesian Well Co.	-	20	150	4	-	do	do
8	Kleins Park	-	-	10	40	-	-	do	Pleistocene
3S2W-1	Maryland Glass Corp.	Downin	-	20	267	6	None	Hard rock	Pre-Cambrian
3S3W-1	General Tire & Rubber Co.	-	1942	108	149	6	do	do	do
3S4W-1	Excelsior Brick Co.	-	1922	200	270	-	-	do	do
1N1E-1	Belvedere Hotel	-	-	100	1105	-	-	do	do
2	Mr. Branzinger	Miller	1899	80	32	4½	-	Sand and/or gravel	Patuxent

Continued

Water level (feet below land surface)			Pumping equipment	Depth of pump below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Pumping	Static	Date			Gallons a minute	Date				
-	-	-	N	-	70	1896	-	N	-	Exact location unknown.
-	-	-	N	-	70	do	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Well covered; exact location unknown.
-	6.83	May 4, 1944	N	-	22	1930±	-	N	-	Water reported high in iron.
-	-	-	N	-	22	do	-	N	-	Do.
-	-	-	N	-	130	-	-	N	-	Exact location unknown. See table of well logs.
-	-	-	N	-	12	-	-	N	-	Exact location unknown.
-	-	-	-	-	-	-	-	-	-	Exact location unknown. Hard rock at 28 feet.
[a]240	-	1943	I	240	80	1943	-	I	59.5	See table of analyses.
-	-	-	-	-	15	1918	-	-	-	Exact location unknown.
-	-	-	-	-	-	-	-	-	-	Do.
-	-	-	-	-	50	-	-	-	-	Do.
-	[a]12	1918	-	-	20	1918	-	-	-	Exact location unknown. See table of well logs.
-	[a]7	do	-	-	22.5	do	-	-	-	Exact location unknown. Hard rock at 11 feet.
-	-	-	-	-	-	-	-	-	-	Exact location unknown. See table of well logs.
-	-	-	N	-	-	-	-	N	-	Well covered.
-	[a]10	1927(?)	R	254	245±	1944	-	I	-	Owner's well 1. See table of analyses.
-	-	-	R	250-255	35	do	-	I	-	Owner's well 2. See table of analyses.
-	[a]30	-	N	-	60	1913±	-	N	57	Well covered. Water reported high in iron.
-	-	-	N	-	-	-	-	N	-	Well covered; exact location unknown. Small yield reported. See table of well logs.
-	2.5	Sept. 9, 1944	N	-	-	-	-	N	-	Dug well. See table of analyses.
-	-	-	N	-	-	-	-	N	-	Well covered; exact location unknown. Water reported high in iron. Ample yield reported.
-	-	-	N	-	-	-	-	N	-	Well covered; exact location unknown.
-	-	-	N	-	-	-	-	N	-	Hard rock at 30 feet. Small yield reported.
-	-	-	N	-	15±	-	-	N	-	See table of well logs.
-	-	-	R	-	-	-	-	N	-	Well dug to 80 feet, drilled from 80 to 270 feet.
-	-	-	N	-	-	-	-	N	-	Hard rock at 40 feet. See table of analyses.
-	[a]29	1918	N	-	40	-	-	N	-	Exact location unknown.

TABLE 15—

Location number	Owner or name	Driller	Date completed	Approximate altitude (feet)	Depth (feet)	Casing diameter (inches)	Depth of screen below land surface (feet)	Principal water-bearing formation: Character of material	Principal water-bearing formation: Geologic age
1N1E-3	Baltimore Polytechnic Institute	-	-	120	-	-	-	-	-
1N2E-1	American Brewery, Inc.	Harper	1907	140	1500	8	-	Hard rock	Pre-Cambrian
2	Do	do	do	140	3000	8	-	do	do
3	Do	-	-	140	600	-	-	do	do
4	-	-	Before 1896	100	315	-	-	do	do
5	-	-	do	100	400	-	-	do	do
6	Suburban Club Carbonated Beverage Co.	-	do	120	286	6	-	do	do
7	Mr. Herring	Miller	1899	90	62	6	-	Sand and/or gravel	Patuxent
8	Mr. Novak	Thomas	Before 1918	80	84	5	-	do	do
1N3E-1	National Fruit Co.	-	-	80	-	6¼	-	do	do
2	Do	-	-	80	45±	6¼	-	do	do
1N5E-1	Baltimore Stamping & Enameling Co.	-	-	15	6	-	-	do	Pleistocene
2N1E-1	Darby Park Brewery	-	Before 1896	-	-	-	-	-	-
2	Fairfield Western Maryland Dairy	Washington Pump & Well Co.	1940	140	790	12¼	None	Hard rock	Pre-Cambrian
3	Do	do	do	160	864	12¼	do	do	do
2N2E-1	VanDer Horst Brewing Co.	-	Before 1896	120	300	10	-	do	do
2	Do	-	do	120	300	10	-	do	do
2N3E-1	Brehm Brewery	Harper	do	140	1500	8	-	do	do
2	Do	-	do	140	1300	-	-	do	do
3	Do	-	-	140	130	-	-	do	do
3N1E-1	City of Baltimore	Riley Engr. & Drilling Co.	1944	226.12	185	3	-	-	-
2	Do	do	do	271.06	230.5	3	-	-	-
3	Do	do	do	226.05	184.5	3	-	-	-
4	Do	do	do	227.05	185	3	-	-	-
3N2E-1	Do	do	do	178.60	135	3	-	-	-
3N3E-1	C. E. Weaver	Hoshall	1907	200	203	6	-	Hard rock	Pre-Cambrian
2	H. A. Weaver	do	do	200	112	6	-	do	do
3N4E-1	C. A. Morningstar	do	1911	220	159	6	-	do	do
4N1E-1	Mr. McCabe	O'Donovan	1898	350	300	-	-	do	do
2	Do	do	do	350	500	-	-	do	do
3	Do	do	do	350	300	-	-	do	do

Continued

Water level (feet below land surface)			Pumping equipment	Depth of pump below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Pumping	Static	Date			Gallons a minute	Date				
-	-	-	-	-	-	-	-	-	-	Exact location unknown.
-	-	-	N	-	10	1918	-	N	-	Well covered; exact location unknown.
-	-	-	N	-	15	do	-	N	-	Do.
-	-	-	N	-	200	do	-	N	-	Do.
-	-	-	N	-	31	1896	-	N	-	Exact location unknown.
-	-	-	N	-	25	do	-	N	-	Do.
-	-	-	N	-	15	do	-	N	-	Well covered.
-	-	-	N	-	0	1918	-	N	-	Exact location unknown.
-	-	-	-	-	40	do	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Well partly filled.
-	20.18	June 12, 1944	N	-	-	-	-	N	-	
-	1.5	June 18, 1943	-	-	-	-	-	I	-	Dug well; dug reservoir 200 by 200 by 6 feet. See table of analyses.
-	-	-	-	-	-	-	-	-	-	Exact location unknown.
[a]331	-	1940	N	-	165	1940	-	N	-	Owner's well 1; well filled with debris to within 29 feet of surface. See table of well logs.
[a]310	-	do	N	-	165	do	-	N	-	Owner's well 2; well covered; exact location unknown. See table of well logs.
-	-	-	N	-	120	1896	-	N	-	See table of analyses. Exact location unknown. Hard rock at 36 feet.
-	-	-	N	-	120	do	-	N	-	Exact location unknown. Hard rock at 36 feet.
-	-	-	N	-	13	do	-	N	-	Exact location unknown. Plugged to 800 feet.
-	-	-	N	-	0	do	-	N	-	Exact location unknown. See table of well logs.
-	-	-	N	-	0	-	-	N	-	Exact location unknown.
-	9.6	February 1945	N	-	-	-	-	N	-	Test well. See table of well logs.
-	10.2	do	N	-	-	-	-	N	-	Do.
-	7.2	do	N	-	-	-	-	N	-	Do.
-	17.2	do	N	-	-	-	-	N	-	Do.
-	3.5	do	N	-	-	-	-	N	-	Do.
-	-	-	-	-	2	1918	-	-	-	Exact location unknown. See table of well logs.
-	-	-	-	-	1	do	-	-	-	Do.
-	[a]62	1918	-	-	1	do	-	-	-	Do.
-	[a]30	do	-	-	-	-	-	N	-	Exact location unknown.
-	[a]30	-	-	-	-	-	-	N	-	Do.
-	[a]30	-	-	-	-	-	-	N	-	Do.

TABLE 15—

Location number	Owner or name	Driller	Date completed	Approximate altitude (feet)	Depth (feet)	Casing diameter (inches)	Depth of screen below land surface (feet)	Principal water-bearing formation	
								Character of material	Geologic age
4N3E-1	A. Bridenstein	Baltimore Artesian Well Co.	1904	250	38	3	-	Sand and gravel	Patuxent
2	Mr. Harper	do	do	280	132	3	-	Sand and/or gravel	do
-	Evergreen Lawn Improvement Assoc.	Harper	-	150	654	-	-	Hard rock	Pre-Cambrian
-	Do	do	1906	180	475	6	-	do	do
-	Do	do	do	180	240	6	-	do	do
4N4E-1	E. H. Glenn	Hoshall	1919	250	93	6	-	do	do
2	R. B. Mason	Baltimore Artesian Well Co.	1895	320	108	3	-	do	Patuxent
3	Mr. Miller	Hoshall	-	270	-	6	-	do	Pre-Cambrian
4N5E--	Community Ice Co.	-	-	-	-	-	-	-	-
5N1E-1	A. Clemons	O'Donovan	1894	400	180	6	-	Hard rock	Pre-Cambrian
5N5E--	J. E. Curtis	-	-	-	-	-	-	-	-
-	Green	Hoshall	1920	-	110	6	-	Hard rock	Pre-Cambrian
-	Mrs. Keinginham	do	1922	-	152	6	-	do	do
6N1E-1	St. Vincent's Orphanage	do	1919	405	144	6	-	do	do
1N1W-1	Stafford Hotel	Rust	1905	100	315	8	-	do	do
2	Western Maryland Dairy	Roulon & Co.	-	150	600	-	-	do	do
3	Stafford Hotel	-	-	100	115	-	-	do	do
2N1W-1	Western Maryland Dairy	Roulon & Co.	1915	190	360	-	-	do	do
2	Do	do	do	190	400	-	-	do	do
2N3W-1	City of Baltimore	Riley Engr. & Drilling Co.	1944	333.05	269	3	-	-	-
2	Do	do	do	355.5	270.5	3	-	-	-
2N4W-1	Do	do	do	411	313	3	N	-	-
3N1W-1	L. T. Appold	-	-	240	125	6	-	Hard rock	Pre-Cambrian
2	Edw. L. Bartlett	-	-	270	300	6	-	do	do
3	N. Bartlett	O'Donovan	1895	220	300	6	-	do	do
4									
4	Wm. T. H. Garrett	do	1895-6	368	342	6	-	do	do
5	John Mathews	do	1896	-	205	6	-	do	do
6	City of Baltimore	Riley Engr. & Drilling Co.	1944	250.6	207.5	3	-	-	-
7	Do	do	do	154.03	110.5	3	-	-	-
3N2W-1	Frank G. Schenuit Rubber Co.	Harr	About 1934	150	65	10	-	Hard rock	Pre-Cambrian
2	Do	do	1944	150	57	6	-	do	do
3	Do	do	1944	150	225	6	-	do	do
4	Do	do	do	150	200	6	-	do	do

Continued

Water level (feet below land surface)			Pumping equipment	Depth of pump below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Pump-ing	Static	Date			Gallons a minute	Date				
-	-	-	-	-	10	1918	-	-	-	Exact location unknown. See table of well logs.
-	-	-	-	-	0	do	-	N	-	Exact location unknown. Hard rock at 132 feet.
-	-	-	-	-	250	do	-	-	-	Exact location unknown.
-	-	-	-	-	0	do	-	-	-	Do.
-	-	-	-	-	36	-	-	-	-	Do.
-	-	-	-	-	-	-	-	-	-	Do.
-	a50	1918	-	-	20	1918	-	-	-	Exact location unknown. See table of well logs.
-	a38	-	-	-	½	-	-	-	-	Exact location unknown. Hard rock at 14 feet.
-	-	-	-	-	-	-	-	N	-	Exact location unknown.
-	-	-	-	-	20	-	-	-	-	Do.
-	-	-	-	-	-	-	-	-	-	Do.
-	-	-	-	-	10	-	-	-	-	Do.
-	-	-	-	-	5	-	-	-	-	Do.
-	-	-	-	-	60	-	-	-	-	Do.
-	-	-	-	-	15	-	-	N	-	Exact location unknown. See table of well logs.
-	-	-	-	-	5	-	-	N	-	Exact location unknown.
-	-	-	-	-	-	-	-	N	-	Exact location unknown. See table of well logs.
-	-	-	-	-	180	-	-	N	-	Exact location unknown.
-	-	-	-	-	220	-	-	N	-	Do.
-	26.7	February 1945	N	-	-	-	-	N	-	Test well. See table of well logs.
-	19.4	do	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	a21	1918	-	-	9	1918	-	-	-	Exact location unknown.
-	-	-	-	-	-	-	-	-	-	Do.
-	a28	1918	-	-	-	-	-	-	-	Exact location unknown. See table of well logs.
-	a50	do	-	-	70	1918	-	-	-	Do.
-	a60	do	-	-	-	-	-	-	-	Do.
-	22.2	February 1945	N	-	-	-	-	N	-	Test well; plugged with cement. See table of well logs.
-	10.3	do	N	-	-	-	-	N	-	Test well. See table of well logs.
-	-	-	I	-	65	1944	-	I	-	Owner's well 1.
-	23.17	Aug. 14, 1944	N	-	15	do	-	N	-	Owner's well 2. Hard rock at 30 feet.
-	-	-	A	-	90	do	-	I	58	Owner's well 3.
-	-	-	A	-	150	do	-	I	-	Owner's well 4.

TABLE 15—

Location number	Owner or name	Driller	Date completed	Approximate altitude (feet)	Depth (feet)	Casing diameter (inches)	Depth of screen below land surface (feet)	Principal water-bearing formation	
								Character of material	Geologic age
3N2W-5	Frank G. Schenuit Rubber Co.	Harr	1944	150	220	6	-	Hard rock	Pre-Cambrian
6	City of Baltimore	Riley Engr. & Drilling Co.	do	134	91	3	-	-	-
7	Green Spring Dairy	E. A. Cook & Son	1937	200	326	8	-	Hard rock	Pre-Cambrian
3N3W-1	E. J. Woods	-	-	370	-	-	-	-	-
3N4W--	Suburban Water Co.	-	-	-	-	-	-	-	-
3N5W-1	City of Baltimore	Riley Engr. & Drilling Co.	1944	405	279	3	N	-	-
4N2W-1	Baltimore Country Club	Downin	-	200	-	6	-	Hard rock	Pre-Cambrian
2	Do	do	-	200	-	6	-	do	do
3	Do	do	-	200	-	6	-	do	do
4	Do	do	-	200	-	6	-	do	do
5	Do	do	-	200	-	6(?)	-	do	do
6	Do	do	-	200	-	6(?)	-	do	do
7	Do	do	-	200	-	6(?)	-	do	do
8	Do	do	-	200	-	6	-	do	do
9	Do	do	-	200	114	6	-	do	do
10	Do	do	-	-	-	2½	-	do	do
-	United Railways Car Barn	-	Before 1918	220	386	6	-	do	do
4N3W-1	C. O. Lee	do	-	280	103	6	-	do	do
-	Hotel Denmore	-	-	420	140	-	-	do	do
-	Do	Hoshall	1911	420	106	-	-	do	do
-	E. A. Jackson	O'Donovan	1896	-	150	6	-	do	do
4N4W-1	Electric Park	do	1898	420	190	6	-	do	do
-	Lucas & Green Co.	-	-	-	-	-	-	-	-
4N5W--	West Arlington Improvement Co.	-	1893	460	197	-	-	Hard rock	Pre-Cambrian
-	Do	O'Donovan	do	460	197	-	-	do	do
5N1W-1	Duncan Black	Hoshall	1929	410	102	6	-	do	do
-	Howard W. Jackson	-	-	-	-	-	-	-	-
-	Roland Park Country School	-	-	-	-	-	-	-	-
-	Michael Jenkins	Downin	-	400	300	8	-	Hard rock	Pre-Cambrian
-	Gilman Country School	-	-	-	-	-	-	-	-
5N2W-1	Dixon	Downin	1908	260	56	6	-	Hard rock	Pre-Cambrian
5N3W--	Otto Mattfeldt	O'Donovan	-	250	158	6	-	do	do
6N1W--	Robinson	Shannahan	1928	-	300	-	-	do	do
-	Henry Schwartz Estate	Beck	1897	-	200	6	-	do	do
AA-Ac 1	John Mathai	-	1845(?)	140	90	-	-	Sand and/or gravel	Patuxent
AA-Ad 1	Anne Arundel County Sanitary Commission	Bunker	1926	30	65	18	-	Sand and gravel	Patapaco
2	Do	Layne-Atlantic	1941	40	95	18-8	65-95	do	do

Continued

Water level (feet below land surface)			Pumping equipment	Depth of pump below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Pumping	Static	Date			Gallons a minute	Date				
-	-	-	A	-	76	1944	-	I	-	Owner's well 5.
-	-	-	N	-	-	-	-	N	-	Test well. See table of well logs.
-	-	-	-	-	18	-	-	-	-	Exact location unknown. See table of well logs.
-	-	-	-	-	-	-	-	-	-	Exact location unknown.
-	-	-	-	-	-	-	-	-	-	Do.
-	-	-	N	-	-	-	-	N	-	Test well. See table of well logs.
-	-	-	N	-	-	-	-	N	-	Well capped.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	A	-	-	-	-	N	-	
-	-	-	N	-	5±	1943	-	N	-	Flowing well; filled with gravel at surface.
-	-	-	N	-	-	-	-	N	-	
-	-	-	N	-	-	-	-	N	-	
-	-	-	N	-	-	-	-	N	-	Well capped.
-	10.01	Jan. 25, 1946	A	-	-	-	-	N	-	Water level measured periodically.
-	-	-	N	-	-	-	-	N	-	Filled with gravel.
-	-	-	-	-	5	-	-	-	-	Exact location unknown.
-	[a]40	1918	-	-	10	1918	-	-	-	Exact location unknown. See table of well logs.
-	-	-	-	-	20	-	-	-	-	Exact location unknown.
-	[a]20	1918	-	-	50	1918	-	-	-	Do.
-	[a]40	do	-	-	15	do	-	-	-	Do.
-	[a]30	do	-	-	75	-	-	-	-	Exact location unknown. See table of well logs.
-	-	-	-	-	-	-	-	-	-	Exact location unknown.
-	[a]30	1918	-	-	-	-	-	-	-	Exact location unknown. Ample yield reported.
-	[a]30	do	-	-	-	-	-	-	-	Do.
-	[a]30	-	-	-	60	-	-	-	-	Exact location unknown.
-	-	-	-	-	-	-	-	-	-	Do.
-	-	-	-	-	-	-	-	-	-	Do.
-	[a]15	1918	-	-	7	1918	-	-	-	Do.
-	-	-	-	-	-	-	-	-	-	Do.
-	[a]6	-	-	-	20	1918	-	-	-	Do.
-	-	-	-	-	-	-	-	-	-	Do.
-	-	-	-	-	-	-	-	-	-	Do.
-	[a]29	1918	-	40+	40+	1918	-	-	-	Do.
-	[a]72	October 1944	R	-	-	-	-	D	-	Dug well. Reported to contain some iron.
[a]25	Flows	-	I	33	225	1943	9	P	55	See tables of analyses and well logs.
[a]54	[a]22	1941	I	63	280	-	11	P	55	Casing cemented. See tables of analyses and well logs.

TABLE 15—

Location number	Owner or name	Driller	Date completed	Approximate altitude (feet)	Depth (feet)	Casing diameter (inches)	Depth of screen below land surface (feet)	Principal water-bearing formation: Character of material	Principal water-bearing formation: Geologic age
AA-Ad 3	Anne Arundel County Sanitary Commission	-	1927	60	62.5	18	-	Sand and/or gravel	Patapsco(?)
4	Charles S. Walton & Co.	Hoshall	1919	45	94	6	-	do	Patapsco
5	Do	do	do	45	127	6	-	do	do
6	Do	do	do	45	157	6	-	do	do
7	Do	do	1923	45	312	6	-	do	Patuxent
8	U. S. Army Ordnance Depot	-	1918	49.1	390	8	385-390	Sand and gravel	do
9	Do	-	do	46.1	149	8	None	Sand	Patapsco
10	Do	-	do	44.9	108	8-6	-	Sand and/or gravel	do
11	Do	-	do	39.9	300 ±	8	-	do	Patuxent
12	D. L. Topping	-	-	65	500	6	-	Hard rock	Pre-Cambrian
13	Do	-	-	65	80	6	-	Sand and/or gravel	Patapsco
14	City of Baltimore, Bureau of Water Supply	Underground Exploration Co.	-	0	35.5	-	-	Sand	do
15	Do	do	-	0	41	-	-	do	do
16	U. S. Army Ordnance Depot	-	-	35.3	83	8	-	do	do
17	East Linthicum Hts. Water Supply	-	1909	160	90	6	-	do	do
18	Do	-	do	160	108	6	-	do	do
19	West Linthicum Hts. Water Supply	-	-	160	-	-	-	-	-
20	Kavanaugh Products, Inc.	Washington Pump & Well Co.	1944	40	392	8	-	Sand	Patuxent
AA-Ae 1	Armour Fertilizer Works	-	1918	10	350	8	-	Sand and/or gravel	do
2	Cooperative Fertilizer Service, Inc.	Cooperative Fertilizer Service, Inc.	1936	10	23	48	-	do	Patapsco
3	Do	do	do	10	65	48	-	do	do
4	U. S. Coast Guard	-	1934	22	195	12-8	185-193	Sand and gravel	do
5	Do	-	-	15	189	6	-	do	do
6	U. S. Revenue Cutter Station	Downin	1901	20	216	6	-	Sand and/or gravel	do

Continued

Water level (feet below land surface)			Pumping equipment	Depth of pump below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Pumping	Static	Date			Gallons a minute	Date				
-	Flows	-	1	36	175	1943	-	P	54.5	See table of analyses.
-	-	-	A	-	28	1942	-	1	55.5	Do.
-	-	-	A	-	32	do	-	I	-	Do.
-	-	-	A	-	46	do	-	1	57	Do.
-	-	-	A	-	48	do	-	I	57	Do.
[a]128	[a]50	1918	N	-	100	1918	1.3	N	-	Owner's well, Bldg. 72. Well covered. See tables of analyses and well logs.
-	[a]48	do	N	-	75	do	-	N	-	Owner's well, Bldg. 73. Well covered. See tables of well logs and analyses.
-	34.19	Jan. 10, 1946	N	-	50	do	-	N	-	Owner's well, Bldg. 71. See tables of well logs and analyses.
-	24.70	do	N	-	-	-	-	N	-	Owner's well, Bldg. 74. See table of well logs.
-	-	-	N	-	-	-	-	N	-	Well filled with debris.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Test boring. See table of well logs.
-	-	-	N	-	-	-	-	N	-	Do.
-	[a]41	November 1918	N	-	30	-	-	N	-	Well covered; exact location unknown. Well filled back to 83 feet depth. See table of well logs.
-	[a]41	1918	N	-	30	1918	-	N	-	See table of analyses.
-	[a]50	-	N	-	12	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Exact location unknown.
[a]90	47.5	1944	1	-	-	-	-	I	-	See tables of well logs and analyses.
-	[a]30 41.96	Aug. 24, 1943 do	A	-	-	-	-	1	56.5	Yield reported small. See table of analyses.
-	12.46	do	R	16	9	1943	-	1	-	See table of analyses.
-	6.8	do	R	16	-	-	-	I	-	Yield reported small. See table of analyses.
-	21.06	Oct. 26, 1945	I	99	-	-	-	N	-	See tables of analyses and well logs.
-	-	-	N	-	150	-	-	N	-	Well covered; exact location unknown. See table of well logs.
-	[a]10	-	N	-	20-	-	-	N	-	Well covered; exact location unknown.

TABLE 15—

Location number	Owner or name	Driller	Date completed	Approximate altitude (feet)	Depth (feet)	Casing diameter (inches)	Depth of screen below land surface (feet)	Principal water-bearing formation: Character of material	Principal water-bearing formation: Geologic age
AA-Ae 7	U. S. Coast Guard	-	-	20	100	-	-	Sand and/or gravel	Patapaco
8	Solley's Grocery Store	-	1893	50	43	-	-	do	do
9	Do	-	1883	50	45	48	-	do	do
10	U. S. Army Ordnance Depot	-	1917	16	75	10	-	do	do
11	Do	-	1918	16.8	75	8-6	-	Sand and gravel	do
12	City of Baltimore, Bureau of Water Supply	Underground Exploration Co.	-	0	38.5	-	-	-	-
13	Do	do	-	0	39	-	-	-	-
14	Do	do	-	0	52	-	-	-	-
15	Do	do	-	0	51.5	-	-	-	-
16	Do	do	-	0	40	-	-	-	-
17	U. S. Coaat Guard	-	-	22	192	-	-	Sand and/or gravel	Patapaco
18	Do	-	-	20	190	-	-	Gravel	do
19	Do	-	-	20	194	-	-	Sand and gravel	do
20	Do	-	-	20	400	-	-	do	Patuxent
AA-Bb 1	District Training School	Hagmann	1927	180	135	-	-	Sand and/or gravel	do
2	Do	Sydnor Pump & Well Co.	1928	140	222	8-6	177-197	do	do
3	Do	Virginia Machinery & Well Co.	1930	180	240	10	10	do	do
4	Do	Layne-Atlantic	1932	110	195	30-24	-	do	Patuxent
5	Do	Washington Pump & Well Co.	1944	120	199	12	145-151 159-178	Sand	do
6	James Lewald	Mitchell Bros.	1930	180	186	6	-	Sand and/or gravel	do
7	Marylaod House of Correction	Downin	1907	225	675	6	-	Hard rock	Pre-Cambrian
8	Do	do	do	225	675	6	-	do	do
AA-Bc 1	Natiooal Plastic Producta Co.	Shannahan	1944	120	190	10-8	170-190	Sand and/or gravel	Patapaco
2	Do	do	1908	120	165	4	-	do	do
3	Anne Arundel County Board of Education	Washington Pump & Well Co.	1932-33	150	105	6	-	do	do
AA-Bd 1	Arundel Corp.	Layne-Atlantic	1927	125	65	48-18	-	Sand	do

Continued

Water level (feet below land surface)			Pumping equipment	Depth of pump below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Pumping	Static	Date			Gallons a minute	Date				
-	-	-	N	-	-	-	-	N	-	Well covered; exact location unknown.
-	-	-	H	-	-	-	-	D	-	Dug well. See table of analyses.
-	-	-	H	-	-	-	-	D	-	Do.
[a]30	[a]13	1918	N	-	35	1918	2	N	-	Well covered. Reported to yield salty water.
-	[a]15.5	do	N	-	20	do	-	N	-	Well covered. Reported to yield salty water. See table of well logs.
-	-	-	N	-	-	-	-	N	-	Test boring. See table of well logs.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	[a]24	-	N	-	-	-	-	N	-	Well covered; exact location unknown.
-	-	-	N	-	-	-	-	N	-	Well covered; exact location unknown. See table of well logs.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
[a]58	-	-	N	-	-	-	-	N	-	Well capped.
-	-	-	I	160	35	1940	-	P	-	Well partly filled with sand; yield reduced.
[a]60	[a]24	1943	I	-	43	1944	1.2	P	-	Pump capacity 50 gal. a min.
-	[a]20	1932	I	40	100	-	-	P	-	Pump capacity 100 gal. a min.
-	13.07	Sept. 29, 1944	I	132	69	1944	-	P	-	See table of well logs.
-	[a]36	-	R	-	10	-	-	D	-	
-	[a]60	-	N	-	52	-	-	N	-	Well covered. See table of analyses.
-	[a]60	-	N	-	52	-	-	N	-	Well covered.
77	43	1944	I	100	250	1944	7.4	I	-	See table of analyses.
-	-	-	I	-	80	do	-	I	-	Well yields considerable sand.
-	-	-	R	-	15	-	-	P	-	Pump capacity 15 gal. a min.
-	-	-	N	-	178	1927	3.7	N	-	Dug and drilled well; flowed when first drilled. Well plugged. See table of well logs.

TABLE 15—

Location number	Owner or name	Driller	Date completed	Approximate altitude (feet)	Depth (feet)	Casing diameter (inches)	Depth of screen below land surface (feet)	Principal water-bearing formation: Character of material	Principal water-bearing formation: Geologic age
AA-Be 1	Walter F. Gardner	Bunker	1941	25	70±	3	-	Sand and/or gravel	Patapsco
2	Hillman's Store	-	1900	120	22	48	-	do	Magothy
3	Anne Arundel County Board of Education	Washington Pump & Well Co.	1932	115	385	4	-	do	Patapaco
4	N. H. Mathews	Novak	1944	50	125	4½	None	Sand	do
5	Do	do	do	50	120	4	do	Sand and/or gravel	do
6	Anne Arundel County Board of Education	do	do	40	134	6	129-134	Sand	do
7	Mr. Williams	Eiler	1945	20	99	2	None	do	Patapaco(?)
AA-Bf 1	Fort Smallwood	-	-	-	-	-	-	Sand and/or gravel	Patapaco
2	Do	-	-	-	360	-	-	Sand	do
3	Do	-	-	-	21.8	48	-	Sand and/or gravel	Raritan
4	Rogers Townsend Boat Co.	-	1936	1	140	2	None	do	Patapaco
AA-Cc 1	U. S. Naval Academy Dairy	Layne-Atlantic	1941	180	408	10	-	do	do
2	Do	Shannahan	1934	180	380	-	-	do	do
3	Do	do	do	180	241	-	-	do	do
4	Do	-	-	180	60	-	-	do	Raritan
5	Anne Arundel County Board of Education	Washington Pump & Well Co.	1932-33	160	210	6	-	do	Patapaco
Bal-Dd	A. C. Cullen	Harper	1923	6	83	-	-	-	-
Bal-Df 1	James Bolwicki	Lancaster	1931	-	80	5-5/8	-	Gabbro	Pre-Cambrian
Bal-Dg 1	Walter Chapman	do	1932	-	57	5-3/8	-	Gneiss	do
Bal-Ea 1	City of Baltimore	Riley Engr. & Drilling Co.	1944	505	202	3	None	Hard rock	-
2	Do	do	do	569	270	3	do	do	-
3	Do	do	do	408	114	3	do	do	-
4	Do	do	do	438	148	3	do	do	-
5	Do	do	do	479	192	3	do	do	-

Continued

Water level (feet below land surface)			Pumping equipment	Depth of pump below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Pumping	Static	Date			Gallons a minute	Date				
-	[a]40	1941	I	-	8	1941	-	D	-	Water reported of good quality.
-	-	-	R	-	-	-	-	D	-	Dug well. Water reported of good quality.
-	-	-	R	-	15	-	-	P	-	See table of analyses.
-	28.06	Sept. 25, 1944	-	-	15	1944	-	D	-	See table of well logs.
-	[a]25	1944	I	40	10	do	-	D	-	
-	39.08	do	H	-	10	do	-	P	-	See table of well logs.
[a]20	[a]14	1945	-	-	5	1945	0.8	D	-	Do.
-	-	-	R	-	-	-	-	P	57	Owner's well, East well. See table of analyses.
-	-	-	I	-	-	-	-	P	60	Owner's well, West well. See tables of analyses and well logs.
-	14.1	Jan. 27, 1944	H	-	-	-	-	N	-	Dug well.
-	Flows	1943	N	-	-	-	-	D	58	Yield small. See table of analyses.
-	-	-	I	164	260	1941	-	I	-	Well filled back to 245 feet.
-	-	-	A	-	10	-	-	N	-	
-	-	-	A	-	10	-	-	N	-	
-	-	-	H	-	-	-	-	D	-	Dug well; cased with bricks.
-	-	-	R	-	15	-	-	P	-	
-	-	-	-	-	30	-	-	-	-	Exact location unknown.
-	-	-	-	-	4	-	-	-	-	Do.
-	-	-	-	-	5	-	-	-	-	Do.
-	-	-	N	-	-	-	-	N	-	Test well, 7.2 mi. northwest of well Bal-Eb3. Not shown on Plate 1. See table of well logs.
-	-	-	N	-	-	-	-	N	-	Test well, 6.7 mi. northwest of well Bal-Eb3. Not shown on Plate 1. See table of well logs.
-	-	-	N	-	-	-	-	N	-	Test well, 6.1 mi. northwest of well Bal-Eb3. Not shown on Plate 1. See table of well logs.
-	-	-	N	-	-	-	-	N	-	Test well, 5.7 mi. northwest of well Bal-Eb3. Not shown on Plate 1. See table of well logs.
-	-	-	N	-	-	-	-	N	-	Test well, 5.2 mi. northwest of well Bal-Eb3. Not shown on Plate 1. See table of well logs.

TABLE 15—

Location number	Owner or name	Driller	Date completed	Approximate altitude (feet)	Depth (feet)	Casing diameter (inches)	Depth of screen below land surface (feet)	Principal water-bearing formation: Character of material	Principal water-bearing formation: Geologic age
Bal-Eb 1	City of Baltimore	Riley Engr. & Drilling Co.	1944	510	225	3	None	Schist	-
2	Do	do	do	620	342	3	do	Hard rock	-
3	Do	do	do	412	210	3	do	do	-
4	Do	do	do	418	309	3	do	do	-
5	Do	do	do	545	285	3	do	do	-
6	Do	do	do	533	250	3	do	do	-
7	Do	do	do	525	280	3	do	do	-
Bal-Ec 1	Do	do	do	355	185	3	do	do	-
2	Do	do	do	373	223	3	do	do	-
-	Kernan Hospital	-	-	-	-	-	-	-	-
Bal-Ed 1	D. M. J. Cromwell	O'Donovan	1899	20	206	6	-	Gneiss	Pre-Cambrian
2	Blake	do	1897	100	-	-	-	-	-
-	C. S. Golding	Downin	-	-	100	6	-	Hard rock	Pre-Cambrian
-	Stein	Hoshall	1924	-	50	6	-	do	do
-	Ellen K. Jenkins	-	-	-	-	-	-	-	-
Bal-Ee 1	W. M. Meise	-	1920(?)	340	12	48	-	Clay	-
2	J. C. Hammerbacker	Hoshall	1922	340	170	6	-	Hard rock	Pre-Cambrian
3	James Primus	do	1921	340	140	-	-	do	do
4	Peter Quivalier	-	1919	200	73	-	-	Sand and/or gravel	Patuxent(?)
5	Harrison Rider	Hoshall	do	340	205	-	-	Hard rock	Pre-Cambrian
6	G. A. Fritz	do	do	200	110	-	-	do	do
7	Dr. Benson	do	1926	120	104	6	-	do	do
-	F. J. Harper	do	1920	-	88	6	-	do	do
-	W. S. Farmer	O'Donovan	1897	-	395	6	-	-	-
-	Mr. Meyer	Hoshall	1921	-	175	6	-	-	-
-	J. Frank Purzer	do	-	6	154	-	-	-	-
Bal-Ef 1	Baltimore Brick Co.	-	1900(?)	90	87	6	-	Sand and/or gravel	Patuxent
2	Do	-	-	90	90	6	-	do	do

Continued

Water level (feet below land surface)			Pumping equipment	Depth of pump below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Pumping	Static	Date			Gallons a minute	Date				
-	7	1944	N	-	-	-	-	N	-	Owner's well, Test well 11, 2 mi. northwest of well Bal-Eb3. Not shown on Plate 1. See table of well logs.
-	-	-	N	-	-	-	-	N	-	Test well, 4.3 mi. northwest of well Bal-Eb3. Not shown on Plate 1. See table of well logs.
-	-	-	N	-	-	-	-	N	-	Test well. See table of well logs.
-	-	-	N	-	-	-	-	N	-	Test well, 3.1 mi. northwest of well Bal-Eb3. Not shown on Plate 1. See table of well logs.
-	-	-	N	-	-	-	-	N	-	Test well, 2.6 mi. northwest of well Bal-Eb3. Not shown on Plate 1. See table of well logs.
-	-	-	N	-	-	-	-	N	-	Test well, 4.8 mi. northwest of well Bal-Eb3. Not shown on Plate 1. See table of well logs.
-	-	-	N	-	-	-	-	N	-	Test well, 1.5 mi. northwest of well Bal-Eb3. Not shown on Plate 1. See table of well logs.
-	-	-	N	-	-	-	-	N	-	Test well. See table of well logs.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	-	-	-	-	-	-	-	Exact location unknown.
-	-	-	-	-	35	-	-	-	-	Do.
-	-	-	-	-	0	-	-	N	-	Do.
-	-	-	-	-	12	-	-	-	-	Do.
-	-	-	-	-	1	-	-	-	-	Do.
-	-	-	-	-	-	-	-	-	-	Do.
-	[a]8	1944	-	-	-	-	-	D	-	Dug well. Water reported to be contaminated by nearby cesspools.
-	-	-	-	-	7	-	-	-	-	Exact location unknown.
-	-	-	-	-	3	-	-	-	-	Do.
-	-	-	-	-	20	-	-	-	-	Do.
-	-	-	-	-	5	-	-	-	-	Do.
-	-	-	-	-	15	-	-	-	-	Do.
-	-	-	-	-	15	-	-	-	-	Do.
-	-	-	-	-	9	-	-	-	-	Do.
-	[a]150	-	-	-	35	-	-	-	-	Do.
-	-	-	-	-	1	-	-	-	-	Do.
-	-	-	-	-	5	-	-	-	-	Do.
-	-	-	R	-	50	1944	-	I	56	Supplies water to several homes. See table of analyses.
-	31.30	Apr. 25, 1944	N	-	-	-	-	N	-	Measured depth 51.5 feet.

TABLE 15—

Location number	Owner or name	Driller	Date completed	Approximate altitude (feet)	Depth (feet)	Casing diameter (inches)	Depth of screen below land surface (feet)	Principal water-bearing formation	
								Character of material	Geologic age
Bal-Ef 3	Baltimore Brick Co.	-	-	90	-	-	-	-	-
4	Mr. Kruse	Harr	1944	125	123	6	None	Sand and/or gravel	Patuxent
5	Jos. Foreacre	do	do	125	128	6	do	do	do
6	Do	-	-	130	12	-	-	do	Patapsco
7	Louis Madl	-	-	105	91.4	48	-	do	Patuxent
8	-	Harr	1944	105	115	6	-	do	do
9	-	Eiler	1943	160	134	2	-	do	do
10	-	do	do	55	135	2	-	Sand	do
11	H. T. Campbell, Nottingham Farm	Harr	1944	70	199	6	-	Hard rock	Pre-Cambrian
12	Huffmaster	do	do	120	128	6	-	Sand and/or gravel	Patuxent
13	H. T. Campbell & Sons Gravel Quarry	Harr	1942	50	385	6	-	Hard rock	Pre-Cambrian
14	John H. Kopleman	Hoshall	1921	40	227	6	-	do	do
15	-	-	1904	100	52	-	-	Sand and/or gravel	Patuxent
16	"Water Hole"	-	-	130	7.5	36	-	-	-
17	-	-	-	100	37	36	-	Sand and/or gravel	Patuxent
18	John R. Dodson	-	-	110	92	-	-	do	do
19	United Clay Mines Corp.	-	1933	110	66	6	-	do	do
20	H. T. Campbell, Nottingham Farm	Harr	1944	90	492	6	-	Hard rock	Pre-Cambrian
21	do	-	-	90	400(?)	-	-	do	do
22	Mr. Shiebeck	Eiler	1943	60	105	2	None	Sand	Patuxent(?)
23	-	do	1945	85	59	2	do	do	do
Bal-Eg 1	Methodist Church Parsonage	Harr	1944	60	405	6	-	Hard rock	Pre-Cambrian
2	N. Lay	-	1942	20	65	1¼	-	Sand and/or gravel	Patapsco
3	Chase Consolidated School	Washington Pump & Well Co.	1939	30	331	6	321-331	do	Patuxent
4	Do	do	1943	30	345	8-6	-	do	do
5	Do	do	1939	30	158	6	-	Sand	Patuxent(?)
-	G. R. Willis	Shannahan	1909	-	180	6	-	-	-
Bal-Fc 1	Howard Laundry & Cleaners	Bunker	1940	150	250	-	-	Hard rock	Pre-Cambrian
2	Do	do	do	150	200	-	-	do	do
3	Do	do	1937(?)	150	-	-	-	-	-
4	Do	do	do	150	70±	-	-	Sand and/or gravel	Patuxent(?)
5	R. B. Tippett	Downin	1910	30	137	6	-	Gabbro	Pre-Cambrian
6	United Railways	-	-	310	161	6	-	do	do
7	Thayer Stock Farm	Hoshall	1911	420	108	6	-	do	do
-	John E. Stenner	-	-	-	-	-	-	-	-
-	A. J. Watkins Realty Co.	Hoshall	1923	-	146	6	-	-	-
-	Hilton Farms Dairy	-	-	-	-	-	-	-	-
-	J. T. McConnell	Hoshall	1921	-	115	6	-	-	-

Continued

Water level (feet below land surface)			Pumping equipment	Depth of pump below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Pumping	Static	Date			Gallons a minute	Date				
-	-	-	N	-	-	-	-	N	-	Well covered; exact location unknown.
-	-	-	-	-	10	1944	-	D	-	
-	[a]106	1944	H	112	15	do	-	D	-	
-	-	-	H	-	0	do	-	D	-	Well reported "dry" in 1943-44.
-	90.8	1944	R	91	0	do	-	D	-	Well cased with brick.
-	80	Aug. 31, 1944	H	-	-	-	-	D	-	
-	-	-	H	-	-	-	-	N	-	
-	[a]30	-	H	-	-	-	-	D	-	See table of well logs.
-	-	-	-	-	1	1944	-	D	-	Do.
-	[a]99.5	1944	H	-	-	-	-	D	-	
-	-	-	R	-	-	-	-	I	-	
-	-	-	-	-	15	-	-	-	-	Exact location unknown.
-	-	-	R	-	0	-	-	D	-	Well reported "dry" in 1943-44.
-	7.13	1944	N	-	-	-	-	N	-	
-	36.46	Nov. 18, 1944	N	-	-	-	-	N	-	Dug well, cased with bricks.
-	[a]81	1944	H	-	-	1944	-	D	-	Dug and drilled well. Ample water supply for household use.
-	60.05	Nov. 18, 1944	H	62.5	-	-	-	N	-	Well reported "dry" in 1943.
-	37.18	Nov. 1, 1944	-	-	24	1944	-	D	-	See table of well logs.
-	-	-	-	-	4	do	-	D	-	
-	-	-	-	-	-	-	-	D	-	See table of well logs.
-	-	-	-	-	-	-	-	D	-	Do.
-	47.85	Sept. 4, 1944	-	-	2	1944	-	D	-	Hard rock at 204 feet.
-	-	-	R	-	-	-	-	D	-	
-	-	-	R	150	-	-	-	P	-	See table of analyses.
-	-	-	R	-	30	1943	-	P	-	Do.
-	-	-	N	-	3.5	1939	-	N	-	See tables of analyses and well logs.
-	[a]8	-	-	-	40	-	-	-	-	Exact location unknown.
-	24	1943	I	-	75	1943	-	I	-	See table of analyses.
-	-	-	I	-	50	do	-	I	-	
-	-	-	N	-	-	-	-	N	-	
-	-	-	N	-	-	-	-	N	-	Well has not been used.
-	[a]18	-	-	-	8	-	-	-	-	Exact location unknown.
-	-	-	-	-	20	-	-	-	-	Do.
-	[a]30	-	-	-	80	-	-	-	-	Do.
-	-	-	-	-	-	-	-	-	-	Do.
-	-	-	-	-	22.5	-	-	-	-	Do.
-	-	-	-	-	-	-	-	-	-	Do.
-	-	-	-	-	15	-	-	-	-	Do.

TABLE 15—

Location number	Owner or name	Driller	Date completed	Approximate altitude (feet)	Depth (feet)	Casing diameter (inches)	Depth of screen below land surface (feet)	Principal water-bearing formation: Character of material	Principal water-bearing formation: Geologic age
Bal-Fc	Geo. J. Schmidt	-	-	-	-	-	-	-	-
Bal-Fe 1	Eastern Stainless Steel Corp.	-	1926	30	130	6	-	Sand and/or gravel	Patuxent
2	Do	Moser	1928	-	175	-	146-175	Sand	do
3	Do	Shannahan	1943	-	-	-	-	Sand and/or gravel	do
4	Do	do	do	-	-	-	-	do	do
5	Do	do	-	-	-	-	-	do	do
6	Do	do	-	-	-	-	-	do	do
7	Do	-	-	-	193	-	-	do	do
8	Do	-	1928	-	229	-	-	do	do
9	Do	-	-	-	200	-	-	do	do
10	Do	-	1923	-	194	-	170-190	do	do
11	Do	Shannahan	do	-	173	16-12	141-169	do	do
12	Do	do	1922	-	167	-	149-163	do	do
13	Do	do	do	-	180	-	163-175	do	do
14	Do	do	-	-	182	-	172-182	Sand and gravel	do
15	Do	do	1922	-	182	12	167-179	Sand and/or gravel	do
16	Baltimore Pure Rye Co.	do	1934	50	379	8	-	Sand and gravel	do
17	Do	do	do	50	374	10	-	Sand and/or gravel	do
18	U. S. Army Air Force Depot	-	-	18	156	8	-	do	do
19	Paul Jones & Co., Inc.	Harr	1936	30	402	8	-	do	do
20	City of Baltimore, Bureau of Water Supply	-	-	20	238	10-8	-	do	do
21	Do	-	-	20	238	10-8	-	do	do
22	Chesterwood Free Excursion Soc.	-	1920	5	41	3	-	do	Pleistocene
23	Do	-	1880±	10	14	60	-	do	do
24	Do	Shannahan	1903	5	172.5	4¼	-	do	Patapsco

Continued

Water level (feet below land surface)			Pumping equipment	Depth of pump below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Pumping	Static	Date			Gallons a minute	Date				
-	-	-	-	-	-	-	-	-	-	Exact location unknown.
-	-	-	1	-	100	1943	-	1	-	Owner's well 7. See table of analyses.
-	71.36	Oct. 23, 1945	1	-	150	-	-	1	56	Owner's well 11. See tables of analyses and well logs.
117.40	-	do	1	-	-	-	-	1	-	Owner's well 12, gravel-walled. See table of analyses.
-	-	-	I	-	-	-	-	I	-	Owner's well 13, gravel-walled. See table of analyses.
126	-	Oct. 23, 1945	I	-	-	-	-	I	-	Owner's well 14, gravel-walled.
201	-	do	I	-	-	-	-	I	-	Owner's well 15, gravel-walled.
-	-	-	N	-	-	-	-	N	-	Owner's well 9, plugged and abandoned.
[a]197	[a]83	1928	N	214	200	1928	1.8	N	-	Owner's well 8, plugged and abandoned.
-	[a]78	1922	N	-	-	-	-	N	-	Owner's well 10, plugged and abandoned.
-	-	-	N	-	-	-	-	N	-	Owner's well 6, plugged and abandoned.
-	-	-	N	-	-	-	-	N	-	Owner's well 5, plugged and abandoned. See table of analyses.
-	-	-	N	-	-	-	-	N	-	Owner's well 4, plugged and abandoned.
-	-	-	N	-	-	-	-	N	-	Owner's well 3, plugged and abandoned.
-	-	-	N	-	-	-	-	N	-	Owner's well 1, plugged and abandoned. See table of well logs.
-	-	-	N	-	-	-	-	N	-	Owner's well 2, plugged and abandoned. See table of analyses.
-	147	May 4, 1943	1	229	275	1943	-	1	-	See table of well logs.
-	[a]113	1943	I	190	312	1941	-	I	-	See table of analyses.
-	40	-	R	-	104	-	-	M	-	Do.
-	85.93	Feb. 22, 1945	N	-	250	1936	-	N	-	Hard rock at 402 feet. Well equipped with water-stage recorder. See table of analyses.
-	-	-	N	-	-	-	-	N	-	Well filled with debris. See table of analyses.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	N	-	-	-	-	P	-	Driven well. See table of analyses.
-	[a]9	1944	H	-	7.5	-	-	P	-	Dug well. See table of analyses.
-	32.78	Apr. 7, 1944	N	-	50	-	-	N	-	Water reported high in iron content. See table of well logs.

TABLE 15—

Location number	Owner or name	Driller	Date completed	Approximate altitude (feet)	Depth (feet)	Casing diameter (inches)	Depth of screen below land surface (feet)	Principal water-bearing formation: Character of material	Principal water-bearing formation: Geologic age
Bal-Fe 25	Merritt	-	-	35	-	-	-	Sand and/or gravel	Patuxent
26	(Formerly) St. Helena Public Water Supply	-	-	15	8	-	-	do	Pleistocene
27	Do	-	-	15	10	-	-	do	do
28	-	-	-	10	-	-	-	do	Patapaco(?)
29	U. S. Army Air Force Depot	-	-	18	230	8-3	-	do	Patuxent
30	Baltimore County Board of Education	Hoshall	1920	60	234	-	-	Hard rock	Pre-Cambrian
31	Owners' Realty Co.	do	1910	125	85	6	-	Sand and/or gravel(?)	Patuxent(?)
32	Do	do	do	125	75	6	-	do	do
33	Do	do	do	125	90	6	-	do	do
34	Do	do	do	125	150	6	-	do	do
35	Do	-	-	125	140	-	-	do	do
36	Back River	O'Donovan	1896	40	209	-	-	Sand and/or gravel	Patuxent
37	Do	do	do	40	60	-	-	do	do
38	H. A. Brehm	Downin	1907	40	136	4	-	do	do
39	Consolidated Gas, Electric Light & Power Co.	Shannahan	1910	5	200	-	-	do	Patapsco
Bal-Ff 1	City of Baltimore Sewage Disposal Plant	Hoshall	1909	20	156	6	-	do	Patuxent
2	Richard Scott	-	-	20	14	48	-	Sand	Pleistocene
3	Diehl	-	1900(?)	25	65	8	-	Sand and/or gravel	Patapaco
4	Do	-	1875(?)	25	25	-	-	do	Pleistocene
5	Geo. G. Stratman	Hoshall	1932	25	28	-	-	do	do
6	Do	-	-	25	180	6	-	do	Patapaco
7	-	Eiler	1943	10	76	2	-	Sand	do
8	-	do	do	20	57	2	-	do	do
9	Thomas	do	do	10	90	2	-	do	do
10	Joe Mariettes Farm	do	do	20	51	2	-	do	do
11	-	do	do	20	68	2	-	do	do
12	H. B. Stengel	-	-	20	100(?)	-	-	Sand and/or gravel	do
13	Hollywood Park Inn	Newkirk	1911	6	133	-	-	Sand	Patuxent
14	-	-	-	85	10	36	-	Sand and/or gravel	Patapaco
15	Thomas	Harr	1944	8	216	6	213-216	Sand	Patuxent
16	Mrs. Patterson	Eiler	do	10	140	2	None	do	Patapaco
17	R. Niller	do	do	10	200	2	do	Sand and gravel	Patuxent
18	Dr. Helldorfer	do	1943	10	176	2	do	do	do
19	Evergreen Park	do	1944	10	40	2	do	Sand	Patapaco

Continued

Water level (feet below land surface)			Pumping equipment	Depth of pump below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Pumping	Static	Date			Gallons a minute	Date				
-	-	-	N	-	-	-	-	-	-	Used for disposal of household sewage.
-	-	-	-	-	-	-	-	N	-	Dug well; exact location unknown. See table of analyses.
-	-	-	-	-	-	-	-	N	-	Do.
-	-	-	-	-	-	-	-	N	-	Do.
-	-	-	A	-	-	-	-	N	-	Well abandoned; exact location unknown. See table of analyses.
-	-	-	-	-	15	-	-	-	-	Exact location unknown.
-	[a]40	-	-	-	10	-	-	N	-	Do.
-	[a]40	-	-	-	10	-	-	N	-	Do.
-	[a]40	-	-	-	10	-	-	N	-	Do.
-	[a]70	-	-	-	10	-	-	N	-	Do.
-	-	-	-	-	-	-	-	N	-	Exact location unknown. See table of well logs.
-	-	-	-	-	0	-	-	N	-	
-	-	-	-	-	20	-	-	N	-	
-	[a]20	-	-	-	25	-	-	N	-	Exact location unknown.
-	-	-	N	-	-	-	-	N	-	
-	43.44	Mar. 1, 1945	R	150	14	-	-	N	-	Water reported high in iron content.
-	[a]10	1943	R	-	-	-	-	D	-	Dug well. See tables of well logs and analyses.
-	[a]24	-	I	-	-	-	-	D	-	Dug and drilled well. Yield reported adequate for domestic use.
-	[a]20	-	H	-	-	-	-	D	-	Dug well. Yield reported adequate for domestic use.
-	-	-	-	-	-	-	-	N	-	
-	-	-	R	-	-	-	-	I	-	Water reported high in iron content.
-	[a]20	-	H	-	-	-	-	D	-	See table of well logs.
-	[a]12	-	H	-	-	-	-	D	-	Do.
-	[a]11	-	H	-	-	-	-	D	-	Do.
-	[a]12	-	H	-	-	-	-	D	-	Do.
-	-	-	H	-	-	-	-	D	-	Do.
-	-	-	N	-	-	-	-	N	-	
-	[a]10	-	N	-	60	-	-	N	-	Well filled and covered. See table of well logs.
-	4	1944	N	-	-	-	-	D	-	Dug well. Yield ample for household use.
-	26.45	Jan. 15, 1944	-	-	15	1944	-	D	-	See table of well logs.
-	-	-	-	-	-	-	-	D	-	Do.
-	-	-	-	-	-	-	-	D	-	Do.
-	-	-	-	-	-	-	-	D	-	Do.
-	-	-	-	-	-	-	-	D	-	Do.

TABLE 15—

Location number	Owner or name	Driller	Date completed	Approximate altitude (feet)	Depth (feet)	Casing diameter (inches)	Depth of screen below land surface (feet)	Principal water-bearing formation: Character of material	Principal water-bearing formation: Geologic age
Bal-Ff 20	Mrs. Meyers	Eiler	1944	10	224	2	None	Sand	Patuxent
21	Mr. Yeatman	do	do	10	90	2	do	Sand and gravel	Pleistocene(?)
22	Roy Zang	do	do	10	67	2	do	Sand	Patapsco
23	Mr. Smith	do	do	10-20	73	2	do	do	do
24	Battle Park	Shannahan	1924	10	232	6	-	do	Patuxent
25	-	Eiler	1943	10	102	2	None	do	Patapsco
26	Baltimore Holding Co.	Dietz(?)	1926(?)	15	215	6	205-215	Sand and/or gravel	Patuxent
27	Do	do	1927(?)	10	215	6	205-215	do	do
28	I. J. Bolton Co.	-	1939	10	91	6	80-90	Gravel	Patapaco(?)
29	Do	-	1937	10	90	6	80-90	do	Patapaco
30	Essex School	-	1916	15	-	-	-	-	-
31	Do	-	1922	15	135	-	-	Sand and/or gravel	Patapsco(?)
32	Do	-	-	15	-	-	-	-	-
33	W. H. Eiler	Eiler	1943	20	100	-	-	Sand	Patapsco
34	Back River Neck School	-	do	20	365	8-6	-	Sand and gravel	Patuxent
-	T. D. Elton	Van Hoy	1942	-	144	6	-	-	-
-	J. F. Eyring	-	1941	-	175	-	-	-	-
-	Glenn L. Martin	Washington Pump & Well Co.	-	-	155	4	-	Sand	Patuxent
Bal-Fg 1	Frank Asher	Asher	-	10	30	4	-	Sand and/or gravel	Pleistocene
2	-	Eiler	1943	10	106	2	-	Sand	Patuxent
3	-	do	do	20	105	2	-	do	Patapaco
4	Bowley's Bar Store	Leatherbury	-	10	160	6-4	-	do	do
5	Edw. H. Dorl	-	-	10	90	8	-	do	do
6	Do	-	1931	10	70	8(?)	-	do	do
7	Mr. Grebe	Eiler	1944	10	150	2	None	do	do
8	J. Marka	Harr	do	10	260	6	do	Sand and/or gravel	do
9	Mr. Baumohl	Eiler	do	10	160	2	do	Sand	do
10	G. Ebert	-	-	10	67	-	-	Sand and/or gravel	do
11	Mr. Hoag	Eiler	1944	10	53	2	None	Sand	do
12	C. Rauacher	do	1945	10	281	3-2	do	do	do
13	Bauernachmidts Manor	do	do	15	117	2	do	do	do
14	Mr. Kaufman	do	do	10	57	2	do	Sand and/or gravel	Patapsco(?)
15	Frederick H. Habicht	do	do	10	274	3-2	do	Sand	Patapsco
Bal-Gc 1	Calvert Distilling Co.	Ranney Water Well Co.	1942	20	33	-	-	do	Pleistocene
2	U. S. Concrete Pipe Co.	Harr	1943	40	144	6	-	Hard rock	Pre-Cambrian
3	Monumental Distillers, Inc.	-	Before 1936	100	59	6	-	Sand and/or gravel	Patuxent

Continued

Water level (feet below land surface)			Pumping equipment	Depth of pump below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Pumping	Static	Date			Gallons a minute	Date				
-	-	-	-	-	-	-	-	D	-	See table of well logs.
-	-	-	-	-	-	-	-	D	-	Do.
-	-	-	-	-	-	-	-	D	-	Do.
-	-	-	-	-	-	-	-	D	-	Do.
-	-	-	N	-	90	-	-	N	-	Exact location unknown. See table of well logs.
-	[a]18	1943	-	-	-	-	-	D	-	See table of well logs.
-	[a]60	1945	R	175	60	1927	-	P	-	Owner's well 1.
57.5	-	Apr. 23, 1945	R	170	8	1945	-	P	-	Owner's well 2. Pump capacity 8 gal. a min.
-	12.87	May 2, 1945	N	-	50	1939	-	N	-	Owner's well 2. See table of well logs.
-	-	-	N	-	50	do	-	N	-	Owner's well 1.
-	-	-	N	-	-	-	-	N	-	Well covered.
-	-	-	N	-	0	-	-	N	-	Do.
-	-	-	N	-	-	-	-	N	-	Do.
-	-	-	-	-	-	-	-	D	-	See table of well logs.
-	42.26	Jan. 25, 1946	R	-	-	-	-	P	-	See tables of analyses and well logs.
-	-	-	-	-	5	-	-	-	-	Exact location unknown.
-	-	-	-	-	45	-	-	-	-	Do.
-	-	-	-	-	-	-	-	-	-	Exact location unknown. See table of well logs.
-	-	-	H	-	-	-	-	D	-	
-	-	-	H	-	-	-	-	D	-	See table of well logs.
-	[a]12	1943	H	-	-	-	-	D	-	Do.
-	-	-	R	-	-	-	-	D	-	Water reported high in iron content.
-	[a]8	-	-	-	-	-	-	-	-	Exact location unknown. Ample yield reported.
-	[a]10	-	-	-	-	-	-	-	-	Exact location unknown.
-	-	-	-	-	-	-	-	D	-	See table of well logs.
-	-	-	-	-	-	-	-	D	-	Do.
-	-	-	-	-	-	-	-	D	-	Do.
-	-	-	-	-	-	-	-	-	-	Exact location unknown
-	-	-	-	-	-	-	-	D	-	See table of well logs.
-	-	-	-	-	5	1945	0.5	D	-	Do.
-	[a]23	1945	-	-	-	-	-	D	-	Do.
[a]8.5	[a]5.5	do	-	-	4	1945	1.4	D	-	
[a]26	[a]21	do	J	63	7	do	1.4	D	-	Do.
24.07	-	Oct. 6, 1943	I	31	1,000	-	-	I	63.5	Collector-type well. See table of analyses.
-	[a]90	-	N	-	10	1943	-	I	-	
-	-	-	-	-	-	-	-	I	-	See table of analyses.

TABLE 15

Location number	Owner or name	Driller	Date completed	Approximate altitude (feet)	Depth (feet)	Casing diameter (inches)	Depth of screen below land surface (feet)	Principal water-bearing formation	
								Character of material	Geologic age
Bal-Gc 4	Monumental Distillers, Inc.	-	Before 1936	100	85 ±	8	-	Sand and/or gravel	Pstuxent
5	Do	Harr	1939	100	85	6	-	do	do
6	Do	do	do	100	75 ±	-	-	do	do
7	Do	do	do	100	75 ±	-	-	do	do
8	Do	do	do	100	75 ±	-	-	do	do
9	Do	do	do	100	-	-	-	-	-
10	Do	-	Before 1936	100	60(?)	6	-	Sand and/or grsvel	Pstuxent
11	St. Gabriels Home	Hoshall	1927	260	260	-	-	Hard rock	Pre-Cambrian
12	All Saints Convent	-	-	320	120	-	-	do	do
13	Do	-	-	320	30	-	-	-	-
14	Calvert Distilling Co.	-	-	20	35	6	-	-	-
15	Do	Washington Pump & Well Co.	-	20	103	6	-	Sand and gravel	Patuxent
16	Do	do	-	20	107	6	-	do	do
17	Do	do	-	20	103	6	-	do	do
18	Do	do	-	20	125	6	-	do	do
19	Do	do	-	20	45	10	-	Sand and/or gravel	Pleistocene(
20	Do	do	-	60	104	10	-	do	Patuxent
21	Monumental Distillers, Inc.	Harr	Before 1936	90	80	8	-	do	do
Bal-Ge 1	Consolidated Gas, Electric Light & Power Co.	Shannahan	1918	10	600	8	-	do	do
2	Do	do	do	10	600	8	-	do	do
3	Baltimore Transit Co.	-	-	10	14	48	-	do	Pleistocene
4	Mutual Chemical Co.	-	-	10	180	8	-	do	Patapsco
5	Crown Cork & Seal Co.	Shannahan	-	12	150	8	-	do	do
6	Consolidated Gas, Electric Light & Power Co.	do	1903	10	226	8	-	Sand	do
7	United R. R. & Electric Co.	Downin	do	10	287	6	-	do	Pstuxent
8	Fort Carroll	-	1900	5	168	6	-	Sand and gravel	Patapsco
9	Do	-	-	6	247	6	-	Sand	do
10	Western Electric Co.	-	-	20	100 ±	-	-	do	do
Bal-Gf 1	Bethlehem Steel Co.	Shannahan	1916	10	260	12-6	233-257	do	do

Continued

Water level (feet below land surface)			Pumping equipment	Depth of pump below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Pumping	Static	Date			Gallons a minute	Date				
-	-	-	N	-	-	-	-	N	-	
-	-	-	I	55	25	1944	-	I	-	
-	-	-	N	-	0	-	-	N	-	Not cased.
-	-	-	N	-	0	-	-	N	-	Do.
-	-	-	N	-	110	1939	-	N	-	Do.
-	-	-	N	-	20	do	-	N	-	Do.
-	46.0	Aug. 1, 1944	N	-	-	-	-	N	-	
-	-	-	-	-	7	-	-	-	-	Exact location unknown.
-	-	-	-	-	12	-	-	-	-	Do.
-	-	-	-	-	12	-	-	-	-	Do.
-	-	-	I	-	-	-	-	N	-	Owner's well 1; original depth not known.
-	-	-	I	-	55	-	-	N	-	Owner's well 2. See tables of analyses and well logs.
-	-	-	N	-	55	-	-	N	-	Owner's well 3. See table of well logs.
-	-	-	I	-	55	-	-	N	-	Owner's well 4; measured depth 35.3 feet. See table of well logs.
-	7.79	Nov. 18, 1944	N	-	55	-	-	N	-	Owner's well 5; measured depth 27.1 feet. See table of well logs.
-	[a]11	-	N	-	450	-	23	N	-	Well plugged.
-	42.13	Mar. 1, 1945	N	-	100	-	-	N	-	Owner's well Warehouse; equipped with water-stage recorder. See table of analyses.
-	-	-	N	-	20	-	-	N	-	Well abandoned and covered.
-	[a]87	1938	N	-	40	-	-	N	-	Well caved.
-	[a]81	1940	I	140	40	1941	3.5	I	-	See table of analyses.
-	11.5	1943	-	-	-	-	-	I	-	Dug well. Yield reported small.
-	-	-	N	-	-	-	-	N	-	Well plugged with cement.
-	-	-	N	-	100	-	-	N	-	Well covered; exact location unknown.
-	-	-	N	-	110	-	-	N	-	Well covered; exact location unknown. See table of well logs.
-	-	-	N	-	50	-	-	N	-	Do.
-	[a]20	Before 1896	N	-	-	-	-	N	-	Ample yield reported. See table of well logs.
-	-	-	N	-	-	-	-	N	-	Water reported 6 feet above land surface in 1862. See table of well logs.
-	-	-	I	-	-	-	-	I	-	
-	33.34	Jan. 18, 1946	A	222	86	1943	-	N	-	Owner's well Wire Mill 3; equipped with water-stage recorder. See table of analyses.

TABLE 15-

Location number	Owner or name	Driller	Date completed	Approximate altitude (feet)	Depth (feet)	Casing diameter (inches)	Depth of screen below land surface (feet)	Principal water-bearing formation: Character of material	Principal water-bearing formation: Geologic age
Bal-Gf 2	Bethlehem Steel Co.	Shannahan	1925	10	248	-	-	Sand	Patapaco
3	Do	do	1926	10	622	12-4½	597-622	do	Patuxent
4	Do	do	1925	10	440	12-6	420-440	do	do
5	Do	do	do	10	610	12-4½	581-610	Gravel	do
6	Do	do	1926	10	625	12-4½	602-625	Sand and/or gravel	do
7	Do	do	1927	10	612	-	-	do	do
8	Do	do	1937	10	618	12-7	587-618	do	do
9	Do	do	1938	10	456	12-4½	441-454	do	do
10	Do	do	1940	10	711	-	-	do	do
11	Do	do	1941	10	633	14	-	do	do
12	Do	do	1926	12	677	16-4½	659-677	Sand and gravel	do
13	Do	do	1916	10	165	6-4½	125-136 149-160	Sand	Patapaco
14	Do	do	1926	10	369	12-4½	309-323 355-369	Sand and/or gravel	Patapaco and Patuxent(?)
15	Do	do	1916	10	226	10-4½	204-210 217-225	Sand	Patapsco
16	Do	do	1926	10	659	16-6	639-659	Sand and gravel	Patuxent
17	Do	do	1916	10	331	10-8	246-331	do	Patapaco
18	Do	do	1926	10	321	12-6	302-320	do	do
19	Do	do	1916	10	251	10-4½	241-249	do	do

Continued

Water level (feet below land surface)			Pumping equipment	Depth of pump below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Pumping	Static	Date			Gallons a minute	Date				
-	-	-	N	-	-	-	-	N	-	Owner's well Wire Mill 4; plugged with cement and abandoned in 1937.
[a]157	[a]100 91	January 1943 Oct. 16, 1945	I	201	460	1943	8	I	-	Owner's well Wire Mill 5. See table of analyses.
-	93.25	do	A	227	95	do	-	N	-	Owner's well Wire Mill 6. See table of analyses.
[a]172	[a]110 93.06	January 1943 Aug. 4, 1943	I	223	550	do	8.8	I	-	Owner's well Wire Mill 7. Well repaired in 1943 by cementing. See tables of analyses and well logs.
-	94.99	Jan. 18, 1946	A	-	110	do	-	I	-	Owner's well Wire Mill 8. Equipped with water-stage recorder Oct. 5, 1943 to Nov. 30, 1944. See table of analyses.
-	-	-	N	-	-	-	-	N	-	Owner's well Wire Mill 9. Well plugged with clay and abandoned in 1937.
[a]140 117	[a]92	January 1943 Oct. 16, 1945	I	240	620	1943	12.4	I	64	Owner's well Wire Mill 10. See table of analyses.
[a]183 191	[a]110	1939 Oct. 16, 1945	I	220	510	do	8	I	63	Owner's well Wire Mill 11. Gravel-walled by two 6-inch gravel conductors, 420 feet deep. See table of analyses.
-	-	-	N	-	-	-	-	N	-	Owner's well Wire Mill 12. Well abandoned. See table of well logs.
[a]176 186	[a]80	May 10, 1943 Oct. 16, 1945	I	-	690	1943	7.2	I	-	Owner's well Wire Mill 12A. See tables of well logs and analyses.
[a]148	[a]110 77.82	January 1943 Oct. 15, 1945	I	-	410	do	10.5	I	63	Owner's well Tin Mill 1. See tables of analyses and well logs.
-	-	-	N	-	-	-	-	N	-	Owner's well Tin Mill 1T. Well covered. See table of well logs.
[a]142	[a]87 49.37	January 1943 Oct. 15, 1945	I	243	375	1943	7.0	I	60	Owner's well Tin Mill 2. Gravel-walled by two 6-inch gravel conductors, 298 feet deep. See table of analyses.
-	[a]17	1916	N	-	100	1916	-	N	-	Owner's well Tin Mill 2T. Well covered. See table of well logs.
[a]168	[a]101 77.85	January 1943 Oct. 15, 1945	I	258	520	1943	7.7	I	63	Owner's well Tin Mill 3. See tables of well logs and analyses.
[a]35	[a]17	1916	N	-	150	1916	-	N	-	Owner's well Tin Mill 3T. Well covered. See table of well logs.
-	46.76	Oct. 15, 1945	A	-	195	1943	-	I	59	Owner's well Tin Mill 4. See table of analyses.
-	-	-	N	-	-	-	-	N	-	Owner's well Tin Mill 4T. Well covered.

TABLE 15—

Location number	Owner or name	Driller	Date completed	Approximate altitude (feet)	Depth (feet)	Casing diameter (inches)	Depth of screen below land surface (feet)	Principal water-bearing formation: Character of material	Principal water-bearing formation: Geologic age
Bal-Gf 20	Bethlehem Steel Co.	Shannahan	1926	10	314	-	-	Sand and gravel	Patapaco
21	Do	do	1920	10	322	-	-	do	do
22	Do	do	1926	10	314	-	-	do	do
23	Do	do	1920	10	177	-	-	do	do
24	Do	do	1929	10	377	16-6	313-329 363-373	do	do
25	Do	do	do	10	330	16-4½	305-330	do	do
26	Do	do	do	10	234	-	-	do	do
27	Do	do	1942	10	581	12	-	do	Patuxent
28	Do	do	1935	10	177	16-11½	147-172	do	Patapaco
29	Do	do	do	10	233	16-11½	200-228	do	do
30	Do	do	1937	10	247	12-11½	215-247	do	do
31	Do	do	do	10	336	12-7	306-336	do	do
32	Do	do	do	10	668	12-7	526-536 571-578 638-668	do	Patuxent
33	Do	do	do	10	330	12-7	299-329	do	Patapsco

Continued

Water level (feet below land surface)			Pumping equipment	Depth of pump below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Pumping	Static	Date			Gallons a minute	Date				
-	-	-	N	-	-	-	-	N	-	Owner's well Tin Mill 5. Well plugged in 1939.
-	26.24	Oct. 15, 1945	A	-	-	-	-	N	-	Owner's well Tin Mill 5T. Well filled back in 1945. See table of analyses.
-	-	-	N	-	-	-	-	N	-	Owner's well Tin Mill 6. Well plugged and abandoned in 1939.
-	-	-	N	-	-	-	-	N	-	Owner's well Tin Mill 6T. Not shown on Plate 4. Exact location unknown. Well covered.
-	[a]94	1938	N	-	-	-	-	N	-	Owner's well Tin Mill 7. Gravel-walled by two 6-inch gravel conductors, 300 feet deep. Plugged with paraffin and cement and abandoned. See table of analyses.
-	57.17	July 12, 1943	N	-	47	1941	-	N	-	Owner's well Tin Mill 8. Plugged with cement and abandoned in 1943. See table of analyses.
-	-	-	N	-	-	-	-	N	-	Owner's well Tin Mill 9. Well plugged and abandoned in 1939.
-	78.11	Oct. 15, 1945	I	-	-	-	-	N	-	Owner's well Tin Mill 10.
-	25.58	do	I	-	480	1943	-	I	-	Owner's well Sheet Mill 1. Gravel-walled by two 6-inch gravel conductors, 128 feet deep. See table of analyses.
[a]111	[a]54 25.27	January 1943 Oct. 15, 1945	I	-	425	do	7.4	I	-	Owner's well Sheet Mill 2; gravel-walled by two 6-inch gravel conductors, 194 feet deep. See table of analyses.
[a]120	[a]64 25.26	January 1943 Dec. 28, 1945	I	196	770	1943	13.7	I	59	Owner's well Hot Strip 1; gravel-walled by two 6-inch gravel conductors, 188 and 197 feet deep. See table of analyses.
[a]149	[a]109 44.67	January 1943 Oct. 15, 1945	I	224	685	do	17.1	I	-	Owner's well Hot Strip 2; gravel-walled by two 6-inch gravel conductors, 278 and 294 feet deep. See table of analyses.
[a]129 118.4	[a]86	do	I	233	620	do	14.4	I	64	Owner's well Hot Strip 3. See table of analyses.
-	43.85	Oct. 15, 1945	I	235	460	do	-	I	-	Owner's well Hot Strip 4; gravel-walled by two 6-inch gravel conductors, 286 feet deep. See tables of well logs and analyses.

TABLE 15—

Location number	Owner or name	Driller	Date com-pleted	Approximate alti-tude (feet)	Depth (feet)	Casing diameter (inches)	Depth of screen below land surface (feet)	Principal water-bearing formation: Character of material	Principal water-bearing formation: Geologic age
Bal-Gf 34	Bethlehem Steel Co.	Shannahan	1937	10	233	12-1½	213-233	Sand and/or gravel	Patapaco
35	Do	do	do	10	680	12-6	530-590 566-577 645-675	do	Patuxent
36	Do	do	do	10	685	12-7	572-583 647-662 670-685	Sand and gravel	do
37	Do	do	do	10	234	12-1¼	221-234	Sand and/or gravel	Patapsco
38	Do	do	do	10	335	12-7	304-335	do	do
39	Do	do	-	10	283	-	-	do	do
40	Do	do	-	10	300	-	-	do	do
41	Do	do	1898	10	170	-	-	do	do
42	Do	do	1900	10	131	-	-	do	do
43	Do	do	-	10	75	-	-	do	Pleistocene
44	Do	do	-	10	210	-	-	do	Patapsco
45	Do	do	1916	10	286	8-4¼	270-284	Sand and gravel	do
46	Do	do	1929	10	209	12-6	191-209	Sand and/or gravel	do
47	Do	do	1919	10	418	12-4¼	398-418	Sand	Patuxent
48	Do	do	do	10	421	12-4¼	400-421	Sand and/or gravel	do
49	Do	do	1927	10	484	-	-	do	do

Continued

Water level (feet below land surface)			Pumping equipment	Depth of pump below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Pumping	Static	Date			Gallons a minute	Date				
[a]156	[a]96 25.37	January 1943 Oct. 12, 1945	I	195	580	1943	9.6	I	-	Owner's well Hot Strip 5; gravel-walled by two 6-inch gravel conductors, 206 and 207 feet deep. See table of analyses.
124.72	-	do	I	237	690	do	-	I	63	Owner's well Hot Strip 6. See table of analyses.
-	85.25	do	I	233	520	do	-	I	-	Owner's well Hot Strip 7. See tables of well logs and analyses.
[a]167	[a]103 24.47	January 1943 Oct. 15, 1945	I	206	620	do	9.7	I	-	Owner's well Hot Strip 8; gravel-walled by two 6-inch gravel conductors, 218 feet deep. See table of analyses.
[a]147	[a]112 44.10	do do	I	226	650	do	18.5	1	59	Owner's well Hot Strip 9; gravel-walled by two 6-inch gravel conductors, 279 and 283 feet deep. See table of analyses.
-	-	-	N	-	-	-	-	N	-	Owner's well Shipyard Boiler House 1. Well plugged and abandoned about 1936. See table of analyses.
-	-	-	N	-	-	-	-	N	-	Owner's well Shipyard Boiler House 2. Well plugged and abandoned about 1936.
-	-	-	N	-	-	-	-	N	-	Owner's well Marine Power House 1. Well plugged and abandoned.
-	-	-	N	-	-	-	-	N	-	Owner's well Marine Power House 2. Well plugged and abandoned.
-	-	-	N	-	-	-	-	N	-	Owner's well Marine Power House 3. Well plugged with clay and abandoned in 1918.
-	-	-	N	-	110	-	-	N	-	Owner's well Marine Power House 4. Well plugged with clay and abandoned in 1918.
-	[a]42	Sept. 12, 1916	N	-	225	1916	-	N	-	Owner's well Marine Power House 5. Well plugged with clay and abandoned in 1918. See table of well logs.
-	26.82	Oct. 16, 1945	A	190	150	1943	-	N	-	Owner's well 40-inch Mill 1. See table of analyses.
-	75.83	do	A	184	48	1940	-	N	-	Owner's well 40-inch Mill 2. See tables of well logs and analyses.
-	76.09	do	A	175	115	do	-	N	-	Owner's well 40-inch Mill 3. See table of analyses.
-	[a]91	1936	N	-	298	1927	-	N	-	Owner's well 40-inch Mill 4; gravel-walled by one gravel conductor, 424 feet deep. Well plugged and abandoned in 1942. See tables of well logs and analyses.

TABLE 15—

Location number	Owner or name	Driller	Date completed	Approximate altitude (feet)	Depth (feet)	Casing diameter (inches)	Depth of screen below land surface (feet)	Principal water-bearing formation: Character of material	Principal water-bearing formation: Geologic age
Bal-Gf 50	Bethlehem Steel Co.	Shannahan	1927	10	286	12-6	274-285	Sand and/or gravel	Patapaco
51	Do	do	1928	10	419	12-8	362-419	do	Patuxent
52	Do	do	1929	10	655	12-6	608-648	do	do
53	Do	do	do	10	667	12-6	617-649	Sand and gravel	do
54	Do	do	-	10	122	-	111-122	Sand and/or gravel	Pleiatocene
55	Do	do	-	10	122	-	-	do	do
56	Do	do	-	10	120	-	-	do	do
57	Do	do	-	10	124	-	-	do	do
58	Do	do	-	10	122	-	-	do	do
59	Do	do	-	10	123	-	-	do	do
60	Do	do	-	10	123	-	-	do	do
61	Do	do	-	10	120	-	-	do	do
62	Do	do	-	10	120	-	-	do	do
63	Do	do	-	10	-	-	-	-	-
64	Do	do	-	10	-	-	-	-	-
65	Do	do	-	10	195	-	-	Sand and/or gravel	Patapsco
66	Do	do	-	10	112	-	-	do	Pleiatocene
67	Do	do	-	10	186	-	-	do	Patapsco

Continued

Water level (feet below land surface)			Pumping equipment	Depth of pump below land aurface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarka
Pump-ing	Static	Date			Gallona a minute	Date				
-	47.23	Jan. 18, 1946	A	226	165	1943	-	N	-	Owner'a well 40-inch Mill 5. Well equipped with water-stage recorder aince July 26, 1943. See table of analysea.
-	76.26	Oct. 16, 1945	A	-	165	do	-	N	-	Owner'a well 40-inch Mill 6. See table of analyaes.
[a]149	[a]101 78.44	January 1943 Oct. 16, 1945	I	203	605	do	12.6	I	-	Owner's well 40-inch Mill 7. See table of analyses.
-	78.86	do	I	250±	480	do	-	I	-	Owner'a well 40-inch Mill 8. See tablea of well logs and analyaes.
[a]37	-	-	N	-	42	-	-	N	-	Owner'a well Rail Mill 1. Well plugged and abandoned in 1904.
-	-	-	N	-	42	-	-	N	-	Owner'a well Rail Mill 2. Well plugged and abandoned in 1904.
-	-	-	N	-	-	-	-	N	-	Owner's well Rail Mill 3. Well plugged and abandoned in 1904.
[a]39	-	-	N	-	57	-	-	N	-	Owner's well Rail Mill 4. Well plugged and abandoned in 1904.
[a]36	-	-	N	-	42	-	-	N	-	Owner'a well Rail Mill 5. Well plugged and abandoned in 1904.
[a]34	-	-	N	-	42	-	-	N	-	Owner'a well Rail Mill 6. Well plugged and abandoned in 1904.
[a]34	-	-	N	-	42	-	-	N	-	Owner'a well Rail Mill 7. Well plugged and abandoned in 1904.
-	-	-	N	-	42	-	-	N	-	Owner'a well Rail Mill 8. Well plugged with cement and abandoned in 1904.
[a]40	-	-	N	-	28	-	-	N	-	Owner's well Rail Mill 9. Well plugged with cement and abandoned in 1904.
-	-	-	N	-	-	-	-	N	-	Owner's well Rail Mill 10. Well plugged with cement and abandoned in 1904.
-	-	-	N	-	-	-	-	N	-	Owner'a well Rail Mill 11. Well plugged with cement and abandoned in 1904.
[a]43	-	-	N	-	300	-	-	N	-	Owner'a well Rail Mill 12. Well covered.
[a]48	[a]31.5	1909	N	-	23	-	1.4	N	-	Owner'a well Rail Mill 13. Well plugged with cement and abandoned in 1904.
[a]45	-	-	N	-	310	-	-	N	-	Owner's well Rail Mill 14. Well plugged with clay and abandoned in 1938.

TABLE 15—

Location number	Owner or name	Driller	Date completed	Approximate altitude (feet)	Depth (feet)	Casing diameter (inches)	Depth of screen below land surface (feet)	Principal water-bearing formation: Character of material	Principal water-bearing formation: Geologic age
Bal-Gf 68	Bethlehem Steel Co.	Shannahan	-	10	176	-	-	Sand and/or gravel	Patapaco
69	Do	do	-	10	123	-	-	do	Pleiatocene
70	Do	do	-	10	133	-	-	do	do
71	Do	do	1903	10	194	8	-	Sand and gravel	Patapaco
72	Do	do	1905	10	301	8	-	Sand	do
73	Do	do	1909	10	206	-	-	Sand and/or gravel	do
74	Do	do	-	10	495	-	-	Sand and gravel	Patuxent
75	Do	do	1916	10	210	8-6	192-210	do	Patapaco
76	Do	do	1918	10	496	-	-	Sand and/or gravel	Patuxent
77	Do	do	1919	10	504	-	-	do	do
78	Do	do	1937-38	10	651	16-7	291-302 624-632 644-651	Sand and gravel	Patapaco and Patuxent
79	Do	do	1917	15	208	12-6	185-209	Sand and/or gravel	Patapaco
80	Do	do	1918	15	216	12-6	191-216	do	do
81	Do	do	1902	10	428	-	-	do	Patuxent

Continued

Water level (feet below land surface)			Pumping equipment	Depth of pump below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Pumping	Static	Date			Gallons a minute	Date				
[a]40	-	-	N	-	198	-	-	N	-	Owner's well Rail Mill 15. Well plugged with cement and abandoned in 1904.
[a]33	-	-	N	-	42	-	-	N	-	Owner's well Rail Mill 16. Well plugged with cement and abandoned in 1904.
[a]66	-	-	N	-	92	-	-	N	-	Owner's well Rail Mill 17. Well plugged with cement and abandoned in 1909.
-	[a]29	1903	N	-	234	-	-	N	-	Owner's well Rail Mill 18. Exact location unknown. Well plugged with cement and abandoned in 1909. Not shown on Plate 4. See table of well logs.
-	[a]24	do	N	-	328	-	-	N	-	Owner's well Rail Mill 19. Exact location unknown. Well plugged with cement and abandoned in 1909. Not shown on Plate 4. See table of well logs.
[a]68	[a]48	Sept. 18, 1909	N	-	261	-	13.1	N	-	Owner's well Rail Mill 20. Well plugged with clay and abandoned in 1938.
[a]78	[a]5	do	N	-	235	-	3.2	N	-	Owner's well Rail Mill 21. Well plugged with clay and abandoned in 1938. See table of well logs.
-	-	-	N	-	240	-	-	N	-	Owner's well Rail Mill 22. Well plugged with clay and abandoned in 1938. See table of well logs.
-	-	-	N	-	-	-	-	N	-	Owner's well Rail Mill 23. Well plugged with clay and abandoned in 1938.
-	-	-	N	-	-	-	-	N	-	Owner's well Rail Mill 24. Well plugged and abandoned in 1938.
135.89	-	Nov. 5, 1945	I	231	-	-	-	I	62	Owner's well Rail Mill 25; gravel-walled by two 6-inch gravel conductors, 280 feet deep. See tables of well logs and analyses.
-	29.50	Jan. 18, 1946	A	178	90	September 1941	-	N	-	Owner's well Open Hearth 1. Well equipped with water-stage recorder since July 26, 1943. See table of analyses.
-	[a]70	September 1946	A	180	106	do	-	N	-	Owner's well Open Hearth 2. See table of analyses.
-	[a]27	1902	N	-	-	-	-	N	-	Owner's well Old Coke Oven 1. Well plugged with cement and abandoned in 1939.

TABLE 15—

Location number	Owner or name	Driller	Date completed	Approximate altitude (feet)	Depth (feet)	Casing diameter (inches)	Depth of screen below land surface (feet)	Principal water-bearing formation	
								Character of material	Geologic age
Bal-Gf 82	Bethlehem Steel Co.	Shannahan	1902	10	213	-	-	Sand and/or gravel	Patapaco
83	Do	do	1902	10	221	-	-	do	do
84	Do	do	do	10	424	-	-	do	Patuxent
85	Do	do	1910	10	538	-	-	do	do
86	Do	do	1911	10	233	-	-	do	Patapsco
87	Do	do	1913	10	223	-	-	do	do
88	Do	do	Before 1902	10	-	-	-	-	-
89	Do	do	1917	10	286	8-4½	257-278	Sand and/or gravel	Patapsco
90	Do	do	Before 1902	10	-	-	-	-	-
91	Do	do	1917	10	288	8-4½	259-284	Sand and/or gravel	Patapaco
92	Do	do	Before 1902	10	-	-	-	-	-
93	Do	do	1923	10	513	10-4½	498-513	Sand and/or gravel	Patuxent
94	Do	do	Before 1902	10	-	-	-	-	-
95	Do	do	1920	10	514	12-4½	502-514	Sand and/or gravel	Patuxent
96	Do	do	Before 1902	10	-	-	-	-	-
97	Do	do	do	10	-	-	-	-	-
98	Do	do	1913-18	10	281	12-4½	253-274	Sand and/or gravel	Patapsco
99	Do	do	Before 1902	10	-	-	-	-	-
100	Do	do	-	10	284	12-4½	253-273	Sand and/or gravel	Patapaco

Continued

Water level (feet below land surface)			Pumping equipment	Depth of pump below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Pumping	Static	Date			Gallons a minute	Date				
-	[a]20	1902	N	-	-	-	-	N	-	Owner's well Old Coke Oven 2. Well plugged with cement and abandoned in 1939.
-	[a]15	September 1941	N	-	-	-	-	N	-	Owner's well Old Coke Oven 3. Well plugged with clay and abandoned in 1939.
-	[a]22	do	N	-	-	-	-	N	-	Owner's well Old Coke Oven 4. Well plugged with cement and abandoned in 1915.
-	-	-	N	-	-	-	-	N	-	Owner's well Old Coke Oven 5. Well plugged and abandoned in 1939.
-	-	-	N	-	-	-	-	N	-	Owner's well Old Coke Oven 6. Well plugged with clay and abandoned in 1939.
-	-	-	N	-	-	-	-	N	-	Owner's well Old Coke Oven 7. Well covered.
-	-	-	N	-	-	-	-	N	-	Owner's well Blast Furnace 1F. Well plugged with cement and abandoned in 1902.
-	49.20	Nov. 5, 1945	A	-	-	-	-	N	-	Owner's well Blast Furnace 1. See table of analyses.
-	-	-	N	-	-	-	-	N	-	Owner's well Blast Furnace 2F. Well plugged with cement and abandoned in 1902.
-	-	-	A	-	-	-	-	N	-	Owner's well Blast Furnace 2. See table of analyses.
-	-	-	N	-	-	-	-	N	-	Owner's well Blast Furnace 3F. Well plugged with cement and abandoned in 1902.
-	107.92	Feb. 5, 1944	A	-	260	1942	-	I	-	Owner's well Blast Furnace 4. See table of analyses.
-	-	-	N	-	-	-	-	N	-	Owner's well Blast Furnace 4F. Well plugged with cement and abandoned in 1902.
-	[a]135	January 1942	A	258	80	1940	-	N	-	Owner's well Blast Furnace 5. See table of analyses.
-	-	-	N	-	-	-	-	N	-	Owner's well Blast Furnace 5F. Well plugged with cement and abandoned in 1902.
-	-	-	N	-	-	-	-	N	-	Owner's well Blast Furnace 6F. Well plugged with cement and abandoned in 1902.
-	[a]128	1942	A	-	125	1940	-	N	-	Owner's well Blast Furnace 7. See table of analyses.
-	-	-	N	-	-	-	-	N	-	Owner's well Blast Furnace 7F. Well plugged with cement and abandoned in 1902.
-	54.25	Nov. 5, 1945	A	-	110	1940	-	N	-	Owner's well Blast Furnace 8. See tables of well logs and analyses.

TABLE 15—

Location number	Owner or name	Driller	Date completed	Approximate altitude (feet)	Depth (feet)	Casing diameter (inches)	Depth of screen below land surface (feet)	Principal water-bearing formation: Character of material	Principal water-bearing formation: Geologic age
Bal-Gf 101	Bethlehem Steel Co.	Shannahan	-	10	163	-	-	Sand and/or gravel	Patapsco
102	Do	do	-	10	122	-	-	do	do
103	Do	do	-	10	-	-	-	-	-
104	Do	do	-	10	118	-	-	Sand and/or gravel	Patapsco
105	Do	do	1932	10	538	16-4¼	496-508 518-534	Sand and gravel	Patuxent
106	Do	do	1940	10	291	20-7	280-291	Sand and/or gravel	Patapsco
107	Do	do	1918	10	271	10-4	243-263	do	do
108	Do	do	do	10	271	10-4	244-265	do	do
109	Do	do	1913	10	164	12-8	152-164	Sand	do
110	Do	do	do	10	224	12-8	206-224	Sand and gravel	do
111	Do	do	do	10	220	12- 6-5/8	181-189 208-220	do	do
112	Do	do	do	10	169	12-8	157-169	Sand	do
113	Do	do	do	10	169	12-8	155-167	do	do
114	Do	do	1914	13.8	226	12-6	213-225	Sand and gravel	do
115	Do	do	do	13	274	12-4¼	244-268	Sand and/or gravel	do
116	Do	do	do	10	176	12-8	155-173	Sand	do

Continued

Water level (feet below land surface)			Pumping equipment	Depth of pump below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Pumping	Static	Date			Gallons a minute	Date				
-	-	-	N	-	-	-	-	N	-	Owner's well Blast Furnace 8F. Well plugged with cemeot and abaodoned.
-	-	-	N	-	-	-	-	N	-	Owner's well Blast Furnace 9F. Well plugged with cement and abandoned.
-	-	-	N	-	-	-	-	N	-	Owner's well Blast Furnace 10F. Well plugged with cement and abandoned.
-	-	-	N	-	-	-	-	N	-	Owner's well Blast Furnace 11F. Well plugged with cement and abandoned.
[a]147	[a]100	January 1943	I	200	540	1943	11.5	I	64	Owner's well Spray Pond 1. See tables of well logs and analyses.
[a]179	[a]138	1941	I	200	480	1941	11.7	N	-	Owner's well Spray Pond 2. See table of analyses.
-	55.32	Oct. 16, 1945	A	185	80	1943	-	N	60	Owner's well Beozol Boiler 1. See table of analyses.
-	55.32	do	A	188	85	-	-	N	60	Owner's well Benzol Boiler 2. See table of analyses.
-	[a]35	1913	N	-	183	1913	-	N	-	Owner's well Coke Oveo 1. Well plugged and abandoned. See tables of well logs and analyses.
-	[a]36	do	N	-	228	do	-	N	-	Owner's well Coke Oven 2. Well plugged and abaodoned. See tables of well logs and analyses.
-	[a]26	do	N	-	-	-	-	N	-	Owner's well Coke Oven 3. Well plugged and abandoned. See tables of well logs and analyses.
-	[a]36	do	N	-	-	-	-	N	-	Owner's well Coke Oven 4. Well plugged aod abandoned. See tables of well logs and analyses.
-	[a]28	do	N	-	-	-	-	N	-	Owner's well Coke Oven 5. Well plugged and abandoned. See tables of well logs and analyses.
-	[a]39	1914	N	-	269	-	-	N	-	Owner's well Coke Oven 6. Well plugged and abandoned. See tables of well logs and analyses.
-	[a]34	1917	N	-	281	-	-	N	-	Owner's well Coke Oven 7. Well plugged and abandoned. See tables of well logs and analyses.
-	[a]29	do	N	-	172	1917	-	N	-	Owner's well Coke Oven 8. Well plugged and abandoned. See tables of well logs and analyses.

TABLE 15—

Location number	Owner or name	Driller	Date completed	Approximate altitude (feet)	Depth (feet)	Casing diameter (inches)	Depth of screen below land surface (feet)	Principal water-bearing formation: Character of material	Principal water-bearing formation: Geologic age
Bal-Gf 117	Bethlehem Steel Co.	Shanoahan	1917	10	278(?)	-	-	Sand and/or gravel	Patapaco
118	Do	do	do	10	280	-	-	do	do
119	Do	do	do	10	295	-	-	do	do
120	Do	do	do	10	279	-	-	do	do
121	Do	do	do	10	527	-	-	do	Patuxeot
122	Do	do	do	-	227	-	-	do	Patapaco
123	Do	do	do	10	266	-	-	do	do
124	Do	do	do	10	609	-	-	do	Patuxent
125	Do	do	do	10	223	-	-	do	Patapaco
126	Do	do	do	10	273	-	-	do	dc
127	Do	do	do	10	271	-	-	do	do
128	Do	do	do	10	272	-	-	do	do
129	Do	do	do	10	279	12-4½	252-269	do	do
130	Do	do	do	10	309	12-4½	299-307	do	do
131	Do	do	do	10	274	-	-	do	do
132	Do	do	do	10	226	-	-	do	do
133	Do	do	do	10	279	-	-	do	do
134	Do	do	do	10	227	-	-	Sand	do
135	Do	do	do	-	513	-	-	Sand and gravel	Patuxent
136	Do	do	do	10	494	12-4½	None	Sand and/or gravel	do

Continued

Water level (feet below land surface)			Pumping equipment	Depth of pump below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Pump-ing	Static	Date			Gallons a minute	Date				
-	-	-	N	-	-	-	-	N	-	Owner's well Coke Oveo 9. Well plugged and abandoned. See table of analyses.
-	-	-	N	-	-	-	-	N	-	Owner's well Coke Oven 10. Well plugged and abandoned. See table of analyses.
-	-	-	N	-	-	-	-	N	-	Owner's well Coke Oven 11. Well plugged and abandoned. See table of analyses.
-	[a]58	1917	N	-	-	-	-	N	-	Owner's well Coke Oven 12. Well plugged and abandoned. See table of analyses.
-	[a]20	do	N	-	-	-	-	N	-	Owner's well Coke Oven 13. Well plugged and abandoned. See table of analyses.
-	-	-	N	-	-	-	-	N	-	Owner's well Coke Oven 14. Well plugged and abandoned. See table of analyses.
-	[a]65	1917	N	-	-	-	-	N	-	Owner's well Coke Oven 15. Well plugged aod abandooed. See table of analyses.
-	[a]15	do	N	-	-	-	-	N	-	Owner's well Coke Oven 16. Well plugged and abandoned in 1926.
-	-	-	N	-	-	-	-	N	-	Owner's well Coke Oven 17. Well plugged and abandoned. See table of analyses.
-	-	-	N	-	-	-	-	N	-	Owner's well Coke Oven 18. Well plugged and abandoned. See table of analyses.
-	-	-	N	-	-	-	-	N	-	Owner's well Coke Oven 19. Well plugged and abandoned. See table of analyses.
-	-	-	N	-	-	-	-	N	-	Owner's well Coke Oveo 20. Well plugged and abandoned. See table of analyses.
-	61.86	Oct. 22, 1945	A	-	-	-	-	N	-	Owner's well Coke Oven 21. See table of analyses.
-	67.94	do	A	-	-	-	-	N	-	Owner's well Coke Oven 22. See table of analyses.
-	61.57	do	A	226	-	-	-	N	-	Owner's well Coke Oven 23.
-	[a]65	1917	N	-	-	-	-	N	-	Owner's well Coke Oven 24. Well plugged and abandoned.
-	-	-	N	-	-	-	-	N	-	Owner's well Coke Oven 25. Well plugged.
-	-	-	N	-	-	-	-	N	-	Owner's well Coke Oven 26. Well plugged and abandoned. See table of well logs.
-	-	-	N	-	-	-	-	N	-	Owner's well Coke Oven 27. Well plugged with clay and abandoned io 1938. See table of well logs.
[a]135	 74.43	September 1941 Oct. 22, 1945	A	-	850	1940	-	N	-	Owner's well Coke Oven 28. See table of analyses.

TABLE 15—

Location number	Owner or name	Driller	Date completed	Approximate altitude (feet)	Depth (feet)	Casing diameter (inches)	Depth of screen below land surface (feet)	Principal water-bearing formation: Character of material	Principal water-bearing formation: Geologic age
Bal-Gf 137	Bethlehem Steel Co.	Shannahan	-	10	281	-	-	Sand and/or gravel	Patapaco
138	Do	do	1936	10	295	16-6	268-288	Sand	do
139	Do	do	1938-39	10	615	16-7	520-530 555-575 585-615	Sand and gravel	Patuxent
140	Do	do	1940	10	302	14-7	271-302	Sand and/or gravel	Patapaco
141	Do	do	Before 1902	10	100	-	-	Gravel	Pleistocene
142	Do	do	do	10	100	-	-	do	do
143	Do	do	do	10	100	-	-	do	do
144	Do	do	do	10	100	-	-	do	do
145	Do	do	do	10	100	-	-	do	do
146	Do	do	do	10	100	-	-	do	do
147	Do	do	do	10	100	-	-	do	do
148	Do	do	do	10	100	-	-	do	do
149	Do	do	do	10	100	-	-	do	do
150	Do	do	do	10	100	-	-	do	do
151	Do	do	do	10	100	-	-	do	do
152	Do	do	do	10	100	-	-	do	do
153	Do	do	do	10	100	-	-	do	do
154	Do	do	do	10	200	-	-	Sand and/or gravel	Patapaco

Continued

Water level (feet below land surface)			Pumping equipment	Depth of pump below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Pump-ing	Static	Date			Gallons a minute	Date				
	[a]80	1941	I	180	-	-	-	I	-	Owner's well Coke Oven 29.
121.18		Dec. 28, 1945								
-	56.39	Oct. 22, 1945	I	-	418	1941	-	I	-	Owner's well Coke Oven 30; gravel-walled by two 6-inch gravel conductors, 234 feet deep. See tables of well logs and analyses.
[a]166	[a]109	1939	I	199	550	1939-41	9.6	I	-	Owner's well Coke Oven 31. See tables of well logs and analyses.
	71	Oct. 22, 1945								
-	62.23	do	I	238	-	-	-	I	-	Owner's well Coke Oven 32. See table of analyses.
-	-	-	N	-	-	-	-	N	-	Owner's well Old Town Water 1. Well plugged with cement and abandoned in 1902.
-	-	-	N	-	-	-	-	N	-	Owner's well Old Town Water 2. Well plugged with cement and abandoned in 1902.
-	-	-	N	-	-	-	-	N	-	Owner's well Old Town Water 3. Well plugged with cement and abandoned in 1902.
-	-	-	N	-	-	-	-	N	-	Owner's well Old Town Water 4. Well plugged with cement and abandoned in 1902.
-	-	-	N	-	-	-	-	N	-	Owner's well Old Town Water 5. Well plugged with cement and abandoned in 1902.
-	-	-	N	-	-	-	-	N	-	Owner's well Old Town Water 6. Well plugged with cement and abandoned.
-	-	-	N	-	-	-	-	N	-	Owner's well Old Town Water 7. Well plugged with cement and abandoned.
-	-	-	N	-	-	-	-	N	-	Owner's well Old Town Water 8. Well plugged with cement and abandoned.
-	-	-	N	-	-	-	-	N	-	Owner's well Old Town Water 9. Well plugged with cement and abandoned.
-	-	-	N	-	-	-	-	N	-	Owner's well Old Town Water 10. Well plugged with cement and abandoned.
-	-	-	N	-	-	-	-	N	-	Owner's well Old Town Water 11. Well plugged with cement and abandoned.
-	-	-	N	-	-	-	-	N	-	Owner's well Old Town Water 12. Well plugged with cement and abandoned.
-	-	-	N	-	-	-	-	N	-	Owner's well Old Town Water 13. Well plugged with cement and abandoned.
-	-	-	N	-	-	-	-	N	-	Owner's well Old Town Water 14. Well plugged with cement and abandoned in 1902.

TABLE 15—

Location number	Owner or name	Driller	Date completed	Approximate altitude (feet)	Depth (feet)	Casing diameter (inches)	Depth of screen below land surface (feet)	Principal water-bearing formation: Character of material	Principal water-bearing formation: Geologic age
Bal-Gf 155	Bethlehem Steel Co.	Shannahan	Before 1902	10	200	-	-	Sand and/or gravel	Patapaco
156	Do	do	1900	10	276	-	-	do	do
157	Do	do	do	10	281	8-6	266-278	do	do
158	Do	do	1905	10	286	8-4½	270-286	do	do
159	Do	do	1908	10	192	8-6	176-192 160-176	do	do
160	Do	do	1906	10	283	-	-	do	do
161	Do	do	1913	10	576	8-4½	541-572	Sand	Patuxeot
162	Do	do	1916	10	288	8-4½	279-284	Sand and gravel	Patapsco
163	Do	do	do	10	190	10-6	168-190	Sand	do
164	Do	do	1917	10	288	-	-	Sand and/or gravel	do
165	Do	do	do	10	225	-	-	do	do
166	Do	do	1919	10	222	10-6	196-216	do	do
167	Do	do	do	10	301	10-6	277-297	do	do
168	Do	do	do	10	308	10-6	283-304	do	do
169	Do	do	do	10	224	10-6	202-222	do	do
170	Do	do	do	10	223	10-6	198-218	do	do
171	Do	do	do	10	290	10-6	274-290	Sand	do
172	Do	do	1925	10	317	10-6	289-311	Sand and/or gravel	do
173	Do	do	1920	10	226	10-6	196-219	do	do
174	Do	do	1925	-	318	10-6	298-317	Sand	do

Continued

Water level (feet below land surface)			Pumping equipment	Depth of pump below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Pump-ing	Static	Date			Gallons a minute	Date				
-	-	-	N	-	-	-	-	N	-	Owner's well Old Town Water 15. Well plugged with cement and abandoned in 1902.
[a]75	[a]24	1900	N	-	186	1900	3.6	N	-	Owner's well Old Town Water 16. Well plugged with cement and abandoned in 1915.
[a]77	[a]24	do	N	-	163	do	3.0	N	-	Owner's well Old Town Water 17. Well plugged with cement and abandoned in 1917.
-	-	-	N	-	150	1905	-	N	-	Owner's well Old Town Water 18. Well covered. See table of analyses.
-	-	-	N	-	150	1908	-	N	-	Owner's well Old Town Water 19. Well covered. See table of analyses.
-	-	-	N	-	150	1906	-	N	-	Owner's well Old Town Water 20. Well covered. See table of analyses.
-	-	-	N	-	150	1913	-	N	-	Owner's well Old Town Water 21. Well covered. See tables of analyses and well logs.
-	-	-	N	175	250	1916	-	N	-	Owner's well Old Town Water 22. Well covered. See table of well logs.
-	[a]46	1916	A	-	-	-	-	N	-	Owner's well Old Town Water 23. See table of well logs.
-	[a]68	1917	N	-	200	1917	-	N	-	Owner's well Old Town Water 24. Well covered.
-	[a]65	1917	A	-	250	do	-	N	-	Owner's well Old Town Water 25.
-	29	Feb. 18, 1944								
-	27.06	Oct. 16, 1944	A	197	113	1941	-	P-I	-	Owner's well Town Water 1. See table of analyses.
-	56.01	do	A	197	87	1942	-	P-I	60	Owner's well Town Water 2. See table of analyses.
-	56.20	do	A	227	103	do	-	P-I	59.5	Owner's well Town Water 3. See table of analyses.
-	28.83	do	A	198	92	1943	-	P-I	58	Owner's well Town Water 4. See table of analyses.
-	28.01	do	A	190	109	do	-	P-I	60	Owner's well Town Water 5. See table of analyses.
-	56.73	do	A	209	103	do	-	P-I	-	Owner's well Town Water 6. Original depth 706 feet. See tables of analyses and well logs.
-	52.53	do	A	223	105	1942	-	P-I	-	Owner's well Town Water 7. See table of analyses.
-	29.68	do	A	202	62	1943	-	P-I	58	Owner's well Town Water 8. See table of analyses.
-	54.93	do	A	218	136	1942	-	P-I	-	Owner's well Town Water 9. See tables of well logs and analyses.

TABLE 15—

Location number	Owner or name	Driller	Date completed	Approximate altitude (feet)	Depth (feet)	Casing diameter (inches)	Depth of screen below land surface (feet)	Principal water-bearing formation	
								Character of material	Geologic age
Bal-Gf 175	Bethlehem Steel Co.	Shannahan	1936	10	300	-	-	Sand and/or gravel	Patapaco
176	Do	do	1940	-	322	14-10	290-322	do	do
177	Bay Shore Park	do	1907	10	743	8	-	Sand	Patuxent
178	Do	do	1905	6	339	8	-	Sand and/or gravel	Patapaco
179	Fort Howard	-	-	10	400	10	-	do	do
180	Do	Harris-Harmon	1938	12	399	18	-	Sand and gravel	do
181	Do	-	-	10	314	-	-	Sand and/or gravel	do
182	Fort Howard School	Shannahan	1930	-	295	6	-	do	do
183	Cheaapeake Terrace School	do	do	-	307	-	-	do	do
184	Harry B. Wolf	-	-	-	16	-	-	do	Pleiatoceoe
185	Do	Shannahan	1907	5	631	6	-	do	Patuxent
186	Do	do	do	5	402	-	-	Sand	Patapaco
187	North Point School	do	-	20	119.9	6	-	do	do
188	Sparrowa Point Bridge Co.	McClintic-Marahall	1930	10	60	3	-	Sand and/or gravel	Patapaco(7)
189	Baltimore Post Office Outiog Club	-	Before 1925	20	13	-	-	do	Pleiatocene
190	Do	-	Before 1931	20	97	6	-	do	Patapaco
191	Bethlehem Steel Co.	Shannahan	-	10	280	8	-	do	do
192	Do	do	-	10	280	8	-	do	do
193	Do	do	1945	10	345	-	-	-	-
194	Do	do	do	10	327	-	-	-	-
195	Do	-	-	-	192	8	-	Sand and/or gravel	Patapaco
196	Do	-	-	-	136	8	-	do	do
197	Do	-	-	-	270	8	-	do	do
198	Do	-	June 1902	-	213	-	-	do	do
199	Do	-	Sept. 1909	-	502	6	-	do	Patuxent

Continued

Water level (feet below land surface)			Pumping equipment	Depth of pump below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Pumping	Static	Date			Gallons a minute	Date				
[a]128 103	[a]96	1943 Oct. 16, 1945	1	209	720	1943	22.5	P-1	61	Owner's well Town Water 10; gravel-walled by two 6-inch gravel conductors. See table of analyses.
[a]169	[a]108 56.17	Feb. 25, 1940 Oct. 16, 1945	1	222	752	1940	12.3	P-1	61	Owner's well Town Water 11. See table of analyses.
-	41.89	Sept. 14, 1944	A	-	150	-	-	P	-	Reported to have had a flow of 50 gal. a min. before 1918. See table of well logs.
-	-	-	A	-	66	-	-	P	-	See table of analyses.
-	[a]49	1940	I	90	285	1940	-	M	59.5	Owner's well 2. See table of analyses.
-	32.9	June 3, 1943	1	90	315	do	-	M	60	Owner's well 3. See tables of analyses and well logs.
-	-	-	N	-	110	-	-	N	-	Well covered.
-	[a]35	-	R	90	50	1930	-	N	-	See table of analyses.
-	32.11	June 12, 1944	N	-	70	do	-	N	-	Well equipped with automatic water-stage recorder since September 1944. See table of analyses.
-	-	-	H	-	-	-	-	P	-	Driven well.
-	[a]3	1907	N	-	150	-	-	-	-	Well filled.
-	-	-	N	-	100	-	-	-	-	Well filled. See table of well logs.
-	-	-	R	-	25	-	-	N	-	See tables of analyses and well logs.
-	-	-	N	-	-	-	-	N	-	Well covered. See table of analyses.
-	-	-	R	-	-	-	-	N	-	Dug well.
-	-	-	R	-	-	-	-	N	-	See table of analyses.
-	48	Feb. 18, 1944	A	-	-	-	-	N	-	Owner's well Old Town Water 26.
-	49	do	A	-	-	-	-	N	-	Owner's well Old Town Water 27. See table of analyses.
-	-	-	N	None	-	-	-	N	-	Owner's well Town Water Test Well 1. See table of well logs.
-	-	-	N	do	-	-	-	N	-	Owner's well Town Water Test Well 2. See table of well logs.
[a]50.1	[a]30	1917(?)	N	-	163	1917(?)	8.1	N	-	Plugged with cement in 1917.
-	[a]31	1916(?)	N	-	-	-	-	N	-	
-	[a]24	1909(?)	N	-	163	1909(?)	-	N	-	Well covered.
[a]54	[a]31	1902(?)	N	-	186	1902	8.1	N	-	Do.
[a]63	[a]2	1909(?)	N	-	364	1909(?)	5.9	N	-	Do.

TABLE 15—

Location number	Owner or name	Driller	Date completed	Approximate altitude (feet)	Depth (feet)	Casing diameter (inches)	Depth of screen below land surface (feet)	Principal water-bearing formation: Character of material	Principal water-bearing formation: Geologic age
Bal-Gf -	Dr. Gilroy	Newkirk	1911	-	113	6	-	Sand	Patapaco
Bal-Gg 1	Dr. Penty	Eiler	1945	10	185	2	None	do	do
2	Mr. Wolf	do	do	10	214	2	do	do	do
Har-Ce 1	Town of Aberdeen	-	-	120	30	11-3	-	Sand and/or gravel	Patuxent
2	Do	-	-	120	46	11-8	-	do	do
3	Do	-	-	125	35	12-8	-	do	do
4	Do	-	-	130	34	12-8	-	do	do
5	Do	-	-	130	31	-	-	do	do
6	Do	Shannahan	-	115	31	-	-	do	do
7	Do	do	-	140	33	-	-	do	do
8	Do	do	-	125	-	-	-	do	do
9	Do	do	-	120	-	-	-	do	do
Har-Cf 1	Harford Diatillery	Arteaian Well Co. Phila-delphia, Pa.	-	45	60(?)	-	-	do	Pleiatocene
2	Do	do	1943	45	58	10	28-58	Sand and gravel	do
Har-Dc 1	Arthur Forney	Harr	1944	145	290	6	-	Hard rock	Pre-Cambrian
2	Mt. View Touriat Camp	-	-	145	230	-	-	do	do
3	Roae Haven Inn	-	-	145	180	-	-	do	do
4	Townsley	Parker	1928	150	50	5-5/8	-	do	do
5	John D. Cadewalader	do	1927	160	75	5-5/8	-	do	do
6	Tom Preaton	do	do	130	55	5-5/8	-	Sand and/or gravel	Patuxent
Har-Dd 1	Federal Houaing Authority	-	1942	80	-	-	-	do	-
2	Do	-	do	60	-	-	-	do	-
3	Harford County Board of Education	-	1927	100	145	6	-	do	Patuxent
4	Altwater & Schoenhala	Baltimore Arteaian Well Co.	1905	90	126.5	3	-	Sand	do
5	F. Bauer	do	do	90	116	6	-	Sand and gravel	do
6	Harford County Board of Education	-	1919	310	50	6	-	Hard rock	Pre-Cambrian
7	Rogera	Lynch	1933	240	102	6	-	do	do
8	P. B. & W. Railroad	-	1891	40	114	-	-	Sand and/or gravel	Patapaco
9	Willoughby Beach Water Co.	Parker	1932	10	146	5-5/8	-	do	Patuxent(?)
Har-De 1	Bata Shoe Co.	-	1939	10	32	151	-	do	Pleiatocene(?)
2	Do	-	do	10	33	120	-	do	do
3	Do	Van Hoy	do	10	345	-	-	Hard rock	Pre-Cambrian
4	Do	-	do	-	24	120	-	Sand and/or gravel	Pleiatocene(?)
5	Do	Shannahan	1944	15	60±	-	-	do	do

Continued

Water level (feet below land surface)			Pumping equipment	Depth of pump below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Pumping	Static	Date			Gallons a minute	Date				
-	[a]26	-	-	-	15	-	-	-	-	Exact location unknown. See table of well loga.
[a]9	[a]5	1945	-	-	5	1945	1.2	D	-	See tsble of well logs.
[a]9	[a]5	do	-	-	5	do	1.2	D	-	Do.
-	-	-	I	28	33	1944	-	P	-	Owner'a well 1.
-	[a]17	1944	I	44	38	do	-	P	-	Owner's well 2.
-	-	-	J	-	17	do	-	P	-	Owner's well 3.
-	-	-	J	-	17	do	-	P	-	Owner's well 4.
-	-	-	J	-	30	do	-	P	-	Owner's well 5.
-	-	-	1	-	28	do	-	P	-	Owner's well 6.
-	-	-	-	-	40	do	-	P	-	Owner'a well 7.
-	-	-	J	-	30	do	-	P	-	Owner'a well 8.
-	-	-	I	-	11	do	-	-	-	
[a]32	-	October 1943	1	58(?)	200	1943	-	1	-	
31.7	30.25	Sept. 1, 1943	A	-	100	do	66	N	-	See table of well logs.
[a]250	60	Auguat 1944	R	250	-	-	-	D	-	See tablea of analyaea and well loga.
-	-	-	-	-	-	-	-	D	-	
-	-	-	-	-	-	-	-	D	-	
-	-	-	-	-	10	-	-	-	-	Exact locatioo uokoown.
-	-	-	-	-	18	-	-	-	-	Do.
-	-	-	-	-	12	-	-	-	-	Do.
-	43.18	Aug. 9, 1944	I	-	-	-	-	N	-	
-	-	-	I	122	-	-	-	N	-	
-	-	-	R	135±	15	1944	-	P	-	
-	-	-	H	-	3	-	-	N	-	See table of well loga.
[a]26	[a]16	-	N	-	50	-	-	N	-	Do.
-	-	-	-	-	6	-	-	-	-	Exact location unkoown.
-	-	-	-	-	20	-	-	-	-	Do.
-	-	-	-	-	-	-	-	N	-	Do.
-	-	-	-	-	38	-	-	N	-	Well plugged. Exact location unknown.
-	8.69	Oct. 2, 1943	I	31	-	-	-	1	-	Owner'a dug well, factory well.
19.30	-	do	1	31	-	-	-	1	-	Owner's dug well, colony well. See table of analyaea.
-	3.04	do	1	-	12	-	-	N	-	Owner's well Bata houae well. See table of well loga.
-	-	-	N	-	-	-	-	N	-	Dug well. Yield reported amall.
[a]30	[a]16	1943	-	-	40	1943	3	P	-	

TABLE 15—

Location number	Owner or name	Driller	Date completed	Approximate altitude (feet)	Depth (feet)	Casing diameter (inches)	Depth of screen below land surface (feet)	Principal water-bearing formation: Character of material	Principal water-bearing formation: Geologic age
Har-De 6	U. S. Army	Layne-Atlantic	1942	53.5	83	24-10	-	Sand and gravel	Pleistocene
7	Do	do	do	59	121	17½-10	71-81	do	do
8	Grabbe	Parker	1932	120	-	6	-	-	-
9	F. O. Mitchell	Morris	1930	65	50	6	-	Sand and/or gravel	Pleistocene
10	Norman Lee	Lancaster	1933	60	52	6	-	Sand and gravel	do
11	Do	do	do	60	52	6	-	Sand and/or gravel	do
12	Dr. Delaney	-	-	40	50±	6	-	do	do
13	L. D. Boyce	-	-	10	43	2	-	do	do
14	Smith Michael Canning Co.	-	-	60	51	6	-	do	do
15	Do	-	-	60	41	8	-	do	do
16	Do	-	-	60	48	6	-	do	do
17	Do	-	-	60	53	6	-	do	do
18	Do	Shannahan	1944	60	61	16-12	-	Sand and gravel	do
19	U. S. Army	-	-	45	251.5	-	-	-	-
Har-Df 1	Do	-	1918	15	140	10-8	130-140	Sand and/or gravel	Pleistocene(?)
2	Do	-	-	16.2	132	10-8	122-132	do	do
3	Do	-	1918	15	135	10-8	125-135	do	do
4	Do	-	-	15	147	10-8	137-147	do	do
5	Do	-	1918	21.4	151	10-8	141-151	do	do
6	Do	-	-	25.6	152	10-8	142-152	do	do
7	Do	Layne-Atlantic	1941	9.4	144	18	-	Sand and gravel	do
8	Do	-	do	34	162	-	151-162	do	do
9	Do	-	do	18.6	152	18-10	83-88 141-151	Sand	do
10	Do	-	do	29.3	161	16	150-161	do	do
11	Do	-	do	32.7	55	18	33-38 43-55	Sand and gravel	Pleistocene
12	Do	Layne-Atlantic	1943	10	-	-	-	-	-
13	Do	-	-	24.1	115	-	-	-	-
14	Do	-	-	24	126	-	-	-	-

Continued

Water level (feet below land surface)			Pumping equipment	Depth of pump below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Pumping	Static	Date			Gallons a minute	Date				
[a]67.5	[a]29	1942	I	-	280	1944	6.7	M	54	Owner'a well Airfield 1. See tablea of analyses and loga.
[a]69	[a]27	do	I	-	300	do	6.0	M	-	Owner's well Airfield 2. See table of well loga.
-	-	-	H	-	6	-	-	M	-	
-	[a]16	1944	R	-	100	-	-	D	-	Water reported to contain iron.
-	-	-	I	-	8	1944	-	D	-	Owner'a well Garage well. Pump capacity 8 gal. a min. See table of well logs.
-	-	-	I	-	8	do	-	D	-	Owner's well House well. Water reported to contain aome iron. Pump capacity 8 gal. a min.
-	-	-	I	-	-	-	-	D	-	
-	[a]25	1944	R	-	-	-	-	D	-	Water reported to contaio iron. Pump capacity 4 gal. a mio.
-	[a]14.3	do	N	-	-	-	-	N	-	
-	[a]14.9	do	N	-	-	-	-	N	-	Caaiog partly filled with aand.
-	[a]14.5	do	I	-	-	-	-	N	-	
18.8	-	do	I	-	40	1944	-	P	-	
-	15.3	do	N	-	500	do	21.3	N	-	Water level 32 feet when pumping 358 gal. a mio. See tables of well loga and analyaea.
-	-	-	N	-	-	-	-	N	-	Owner's well Test well 20. See table of well logs.
-	[a]18	-	A	100	-	-	-	N	-	Owner'a well 250.
-	[a]17	-	A	119	-	-	-	N	-	
-	[a]23	-	A	-	-	-	-	N	-	Owner'a well 255.
-	[a]28	-	A	114	-	-	-	N	-	Owner'a well 256.
-	[a]32	-	A	127	-	-	-	N	-	Owner'a well 257.
-	[a]40	-	A	-	-	-	-	N	-	Owner'a well 258.
[a]87	[a]31	1941	I	90	267	1944	2.9	M	-	Owner'a well 7. Water turbid. See table of well logs.
[a]69	[a]50	1944	I	-	500	do	22.6	-	-	Owner'a well 8. See table of well logs.
[a]64.9	[a]41.9	do	I	-	645	do	20.7	M	-	Owner'a well 9. See table of well loga.
[a]67.5	[a]47	1941	I	80	590	do	24.4	M	-	Owner's well 10A. See table of well loga.
[a]36	[a]11	do	I	30	60	do	7.8	M	-	Owner'a well 11. See table of well loga.
-	-	-	I	-	35	do	-	M	-	Owner's well Speautie Island well.
-	-	-	N	-	-	-	-	N	-	Owner's well Teat well 13. See table of well logs.
-	-	-	N	-	-	-	-	N	-	Owner's well Teat well 12. See table of well loga.

TABLE 15—

Location number	Owner or name	Driller	Date completed	Approximate altitude (feet)	Depth (feet)	Casing diameter (inches)	Depth of screen below land surface (feet)	Principal water-bearing formation: Character of material	Principal water-bearing formation: Geologic age
Har-Df 15	U. S. Army	-	-	20	-	-	-	-	-
16	Do	-	-	61	100	-	-	-	-
17	Do	-	-	31.5	165	-	-	-	-
18	Do	-	-	30	-	-	-	-	-
19	Do	-	-	20	-	-	-	-	-
20	Do	-	-	66.7	60	-	-	-	-
21	Do	-	-	65	-	-	-	-	-
22	Do	-	-	58	105	-	-	-	-
23	Do	-	-	10	-	-	-	-	-
24	Do	-	-	55	67	-	-	-	-
25	Do	Layne-Atlantic	1946	32.5	179	-	-	-	-
Har-Ed 1	Do	do	1941	24.8	129	-	-	-	-
2	Do	do	do	16.7	126	-	-	-	-
3	Do	do	do	16.5	127	-	-	-	-
4	Do	do	do	7	90	18-10	45-50 65-70 75-90	Sand	Pleistocene and Patapaco
5	Do	do	do	11.6	225	-	-	-	-
6	Do	do	do	11	215	18-10	145-175 200-215	Sand	Cretaceoos
7	Do	do	do	9	73	18-10	45-50 68-73	do	Pleistocene(?)
8	Do	do	do	28.6	125	-	-	-	-
9	Do	do	do	21.5	105	18	50-55 65-70 89-104	Sand and gravel	Pleistocene and Patapsco
10	Do	do	do	10.2	137	-	-	-	-
11	Do	do	do	10	139	18-10	70-75	Gravel	Pleistocene(?)
12	Do	do	do	10	125	-	-	-	-
13	Do	do	do	20.2	125	-	-	-	-
14	Do	do	do	11	80	18-10	55-60 70-80	Sand	Pleistocene(7)
15	Do	do	do	11	365	18-10	145-165 185-190 345-365	do	Patapaco and Patuxent

Continued

Water level (feet below land surface)			Pumping equipment	Depth of pump below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Pumping	Static	Date			Gallons a minute	Date				
-	-	-	N	-	-	-	-	N	-	Owner's well Test well 14.
-	-	-	N	-	-	-	-	N	-	Owner's well Test well 15. See table of well logs.
-	-	-	N	-	-	-	-	N	-	Owner's well Test well 21. See table of well logs.
-	-	-	N	-	-	-	-	N	-	Owner's well Test well 23.
-	-	-	N	-	-	-	-	N	-	Owner's well Test well 16.
-	-	-	N	-	-	-	-	N	-	Owner's well Test well 17. See table of well logs.
-	-	-	N	-	-	-	-	N	-	Owner's well Test well 18.
-	-	-	N	-	-	-	-	N	-	Owner's well Test well 22. See table of well logs.
-	-	-	N	-	-	-	-	N	-	
-	-	-	N	-	-	-	-	N	-	Owner's well Test well 19. See table of well logs.
-	-	-	N	-	0	1946	-	N	-	
-	-	-	N	-	-	-	-	N	-	Owner's well Test well 24A. See table of well logs.
-	-	-	N	-	-	-	-	N	-	Owner's well Test well 12A. See table of well logs.
-	-	-	N	-	-	-	-	N	-	Owner's well Test well 10A. See table of well logs.
-	-	-	I	-	120	1941(?)	-	M	-	Owner's well 23A. See table of well logs.
-	-	-	N	-	-	-	-	N	-	Owner's well Test well 2A. See table of well logs.
-	-	-	I	-	90	1941(?)	-	M	-	Owner's well 23B. Test well drilled to rock at 364 feet. See table of well logs.
-	-	-	I	-	200	do	-	M	-	Owner's well 23C. See tables of analyses and well logs.
-	-	-	N	-	-	-	-	N	-	Owner's well Test 5A. Casing not installed. See table of well logs.
-	25.36	Apr. 13, 1944	N	-	-	-	-	N	-	Owner's well 23D. See table of well logs.
-	-	-	N	-	-	-	-	N	-	Owner's well Test well 7A. See table of well logs.
-	-	-	N	-	-	-	-	N	-	Owner's well 8A. See table of well logs.
-	-	-	N	-	-	-	-	N	-	Owner's well Test well 26A. See table of well logs.
-	-	-	N	-	-	-	-	N	-	Owner's well Test well 25A. See table of well logs.
-	-	-	I	-	110	1944	-	M	-	Owner's well 23F. See tables of analyses and well logs.
-	-	-	I	-	182	do	-	M	-	Owner's well 23E. See tables of analyses and well logs.

TABLE 15—

Location number	Owner or name	Driller	Date completed	Approximate altitude (feet)	Depth (feet)	Casing diameter (inches)	Depth of screen below land surface (feet)	Principal water-bearing formation	
								Character of material	Geologic age
Har-Ed 16	U. S. Army	Layne-Atlantic	1941	16.5	120	18-10	70-75 85-95 115-120	Sand and gravel	Pleistocene(?) and Patapaco
17	Do	do	do	18.3	125	-	-	-	-
18	Do	do	do	14.3	140	-	-	-	-
19	Do	do	do	12.5	120	18-10	105-120	Sand and gravel	Patapaco
20	Do	do	do	23	117	18-10	80-90 102-117	do	do
21	Do	do	do	14.3	121	18-10	106-121	do	do
22	Do	do	do	16.3	315	-	-	-	-
23	Do	do	do	14.5	133	18-10	100-110 115-120 125-130	Sand and gravel	Patapaco
24	Do	do	do	12.8	135	18-10	120-135	Sand	do
25	Do	do	do	13.9	125	-	-	-	-
26	-	-	-	-	22	-	-	Sand and/or gravel	Pleistocene
27	Mrs. Richardson	Parker	1928	-	118	5-5/8	-	do	Patapaco
28	U. S. Army	Layne-Atlantic	1941	5	402	-	-	-	-
How-Cf 1	Maryland State Police	Washington Pump & Well Co.	1937	232	201	8-6	-	Hard rock	Pre-Cambrian
How-Cg 1	Spencer Heath	Hoshall	1921	-	165	6	-	do	do
2	Murray	do	1929	-	170	6	-	do	do
3	McSherry	Schultz	1908	-	304	-	-	do	do
4	Grace Church Rectory	-	-	-	60	-	-	do	do
5	St. Augustines Church	-	1933	-	90	6	-	Sand(?)	Patuxent(?)

Continued

Water level (feet below land surface)			Pumping equipment	Depth of pump below land surface (feet)	Yield		Specific capacity (g.p.m./ft.)	Use of water	Temperature (°F.)	Remarks
Pumping	Static	Date			Gallons a minute	Date				
-	-	-	I	-	133	1944	-	M	-	Owner's well 23G. See tables of analyses and well logs.
-	-	-	N	-	-	-	-	N	-	Owner's well Test well 28A. See table of well logs.
-	37.55	Apr. 13, 1944	I	-	-	-	-	M	-	Owner's well Test well 23M. See table of well logs.
-	-	-	I	-	385	1944	-	M	-	Owner's well 23I. See tables of analyses and well logs.
-	-	-	I	-	316	do	-	M	-	Owner's well 23H. Test well drilled to 139 feet. See tables of analyses and well logs.
-	-	-	I	-	-	-	-	N	-	Owner's well 23K. See table of well logs.
-	-	-	N	-	-	-	-	N	-	Owner's well Test well 35A. See table of well logs.
-	-	-	N	-	300	1941(?)	-	N	-	Owner's well Test well 30A. See table of well logs.
-	8.24	Apr. 13, 1944	I	-	-	-	-	N	-	Owner's well 23N. Test well drilled to 149 feet. See table of well logs.
-	-	-	N	-	-	-	-	N	-	Owner's well Test well 32A. See table of well logs.
-	-	-	N	-	-	-	-	N	-	Dug well, high iron content reported. Well reported to have a flow in winter.
-	-	-	-	-	0.5	-	-	-	-	Exact location unknown.
-	-	-	N	-	-	-	-	N	-	Owner's well Test well 1. See table of well logs.
-	-	-	R	176	12	-	-	P	-	See tables of analyses and well logs.
-	-	-	R	-	30	-	-	D	-	See table of analyses.
-	-	-	-	-	25	-	-	-	-	Exact location unknown.
-	-	-	-	-	17	-	-	-	-	Do.
-	-	-	-	-	-	-	-	-	-	Exact location unknown. Ample yield and high iron reported.
-	-	-	-	-	-	-	-	-	-	Do.

LOGS OF WELLS

Most of the well logs in Table 16 were reported by drillers. The logs of the following wells were obtained from J. T. Singewald, Jr., who prepared them from examination of cores: 3N1E-1-4, 3N2E-1, 2N3W-1 and 2, 2N4W-1, 3N1W-6 and 7, 3N2W-6, 3N5W-1, Bal-Ea 1-5, Bal-Eb 1-7, and Bal-Ec 1 and 2. The descriptions of the material given in the drillers' logs are essentially as they were reported; and contain a few terms that are not strictly geological. The terms "crust," "iron ore," and "boulder" refer to the hard layers or concretionary masses of ferruginous sandstone in the Cretaceous sediments. The term "free" apparently is used to describe sand or gravel that is free of clay. The drillers' use of the term "granite" generally indicates merely bedrock, and not that the drill cuttings were actually identified as granite.

The geological classification of the logs was made by the writers. Many of the logs are either too generalized or too incomplete to permit an accurate geological classification, so that for many wells the logs may not show accurately the thickness of the formations. In most of the logs, except those of shallow wells on its outcrop, the Raritan formation has been included with the Patapsco formation.

TABLE 16
Logs of Wells in the Baltimore Area

	Thickness (feet)	Depth (feet)
1S1E-15		
"Cellar"	31	31
Patuxent formation:		
Sand and gravel (water at 55 feet)	26	57
Clay, mixed	19	76
Pre-Cambrian rocks:		
Rock	14	90
1S1E-17		
Pleistocene deposits:		
Mud, black	20	20
Loam, yellow; gravel (water)	10	30
Clay, yellow	11	41
Patuxent formation:		
"Kaolin," hard	4	45
Gravel, white (water)	5	50
1S3E-1		
Patuxent formation:		
Sand; some clay	125	125
Pre-Cambrian rocks:		
Mica rock	250	375
Granite (?), white (probably limestone)	20	395
1S3E-2		
Recent and Pleistocene deposits:		
Cinders and clay	15	15
Arundel and Patuxent formations:		
Clay, sandy	5	20
Clay, red, tough	20	40
Sand and clay	9	49
Boulders	4	53
Clay, sandy	7	60
Sand, yellow	25	85
Sand, yellow, fine	9	94
Clay, yellow, tough	42	136
Gravel, coarse; sand, fine, sharp	12	148
Sand	6	154
Clay, tough	7	161
Sand, coarse; gravel at bottom	34	195

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
1S3E-3		
Recent deposits:		
Brick and cinder fill	12	12
Arundel and Patuxent formations:		
Clay, red, hard	132	144
Sand, white	17	161
Clay, blue, hard	7	168
Sand and gravel	21	189
Clay, varicolored; boulders, small	34	223
Sand and gravel	22	245
Clay, blue, soft	17	262
Pre-Cambrian rocks (?):		
Sand, dark gray; possibly weathered granite	5	267
Granite	5	272
1S3E-4		
Arundel and Patuxent formations:		
Clay, light gray to maroon-mottled	15	15
Sand, buff, moderately coarse	20	35
Clay	75	110
Sand, clayey	27	137
Gravel and some clay pellets and balls	5	142
Sand and gravel with clay balls	5	147
Gravel, quartz; sand with some clay balls	8	155
Gravel and sand, clayey	14	169
Sand and gravel with clay balls	10	179
Sand and gravel	16	195
1S3E-7		
Recent deposits:		
Fill	5	5
Patuxent formation:		
Clay, sandy	10	15
Sand	10	25
Sand and gravel	5	30
Sand and clay, mixed	3	33
Clay, white; silica	5	38
Clay, sandy, white and red	3	41
Clay, red; sand and gravel	3	44
Clay, red, yellow, and white; sand and gravel	5	49
Clay, white and yellow	5	54
Clay, white; silica	2	56
Clay, white, yellow, and red; sand, coarse	3	59

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Clay, red brick	10	69
Clay, red, some streaks of blue	2	71
Sand (water)	2	73
Clay, red, some streaks of white	23	96
Clay and sand	22	118
Sand and clay	7	125
Sand and gravel	5	130
Clay, red, white, and yellow; sand and gravel	5	135
Sand and gravel	15	150
Sand and gravel; mica	5	155
Sand and gravel; mica (water)	5	160
"Alum" and sand	15	175
Sand, coarse	7	182
Pre-Cambrian rocks:		
Shale, green, and sand; muscovite	7	189
Shale, green; sand and graphite	15	204
Graphite	4	208
Shale, green; sand and graphite	24	232
1S3E-8		
Recent deposits:		
Cinders and fill	6	6
Arundel and Patuxent formations:		
Sand, yellow	24	30
Clay, sandy, red; boulders	59	89
Clays, varicolored, tough	30	119
Shale, hard	1	120
Clay, brown; boulders	15	135
Sand and gravel, fine	6	141
Clay, bluish gray; boulders	29	170
Sand, clay, and boulders	21	191
Pre-Cambrian rocks:		
Granite, soft, weathered	6	197
Granite	14	211
1S3E-11		
Arundel and Patuxent formations:		
Clay, red, smooth	70	70
Clay, white, somewhat sandy; smooth red clay at 90 feet	20	90

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
1S3E-12		
Arundel and Patuxent formations:		
Clay, red	75	75
Clay, yellow	65	140
Sand and gravel (water)	43	183
1S3E-15		
Arundel and Patuxent formations:		
(Water encountered at 135, 160, and 210 feet; sand rock at 216 feet)	216	216
Pre-Cambrian rocks:		
Granite	14	230
(Not reported)	130	360
Limestone	25	385
(Not reported). Granite at 408 feet	23	408
1S3E-16		
Arundel and Patuxent formations:		
(Not reported)	227	227
Pre-Cambrian rocks:		
Rock, black	33	260
Marble, white	50	310
1S3E-17		
Arundel and Patuxent formations:		
(Not reported)	224	224
Pre-Cambrian rocks:		
Rock, soft; hard rock at 227 feet	3	227
(Not reported)	63	290
1S3E-19		
Recent deposits:		
Cinders and fill	15	15
Arundel clay:		
Clay, red	19	34
Patuxent formation:		
Sand, packed	5	39
Clay, yellow	20	59
Sand, hard packed	18	77
Shale	4	81
Gumbo, red	28	109
Sand, fine	8	117
Gumbo	6	123

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Sand	6	129
Sand, coarse	20	149
Gravel; clay at 153 feet	4	153
1S3E-21		
Arundel and Patuxent formations:		
Clay, red	80	80
Sand, yellow, fine (water)	30	110
Clay, red	50	160
Sand and gravel (water)	30	190
Sand, white, fine	20	210
Hardpan. Loose conglomerate of small gravel and coarse sand; variegated clay, blue, yellow, white, and slightly greenish	100	310
Pre-Cambrian rocks:		
Gneiss rock, alternatingly hard and soft	225	535
1S3E-34		
Arundel and Patuxent formations:		
(Not reported)	160	160
Sand (water)	10	170
(Not reported)	50	220
Clay, yellow	20	240
Sand and gravel (water)	20	260
Clay, yellow (water); loose shell-like rocks at 320 feet	60	320
(Not reported)	80	400
1S3E-41		
Patuxent formation:		
(Not reported)	87	87
Clay	6	93
Sand	16	109
Pre-Cambrian rocks:		
Rock	291	400
1S4E-1		
Recent deposits:		
Fill	10	10
Pleistocene deposits:		
Sand and boulders	30	40

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Arundel and Patuxent formations:		
Clay	138	178
Sand and gravel, medium (water)	18	196
Mica	4	200
Sand and gravel, medium (water)	10	210
Mica	2	212
Sand and gravel, medium (water)	8	220
Mica	11	231
Pre-Cambrian rocks:		
Bedrock	2	233
1S4E-2		
Recent and Pleistocene deposits:		
Surface fill and gravel	20	20
Sand and gravel	20	40
Arundel and Patuxent formations:		
Clay, red	29	69
Boulders, gravel, and sand	12	81
Clay, tough	16	97
Boulders imbedded in clay	8	105
Clay	25	130
Clay, sandy; gravel	38	168
Sand, fine; streaked with clay	12	180
Clay, sandy; gravel	10	190
Sand, medium; with clay balls (water)	25	215
Gravel, heavy, imbedded in very tough clay; mica	4	219
Pre-Cambrian rocks:		
Clay, dark blue; weathered mica	8	227
Mica rock	7	234
1S4E-3		
Arundel and Patuxent formations:		
(Not reported)	150	150
Sand and gravel, white	50	200
Pre-Cambrian rocks:		
Gneiss	50	250
Gneiss with much muscovite and garnet	13	263
1S4E-19		
Pleistocene deposits:		
Clay, red; sand, fine	17	17
Gravel (no water)	11	28

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Arundel and Patuxent formations:		
Sand, light brown, mixed with clay	65	93
Clay, red	93	186
Sandstone	1	187
Sand, coarse	3	190
Clay, varicolored	27	217
Sandstone	2	219
Sand and gravel	18	237
Pre-Cambrian rocks:		
Granite, weathered	13	250
2S1E-3		
Recent deposits:		
Cinder fill	10	10
Arundel and Patuxent formations:		
Clay, red	52	62
Sandstone	2	64
Sand, gray, fine	7	71
Clay, red, tough	16	87
Sand, brown, fine	4	91
Clay, blue, soft	7	98
Sand, dark brown	4	102
Clay, blue	29	131
Gravel and sand	19	150
Clay, blue	11	161
2S1E-16		
Arundel and Patuxent formations:		
Clay, red	55	55
Sand, yellow (water)	5	60
Clay, red	10	70
Clay, white	20	90
Clay, white; sand	6	96
Sand, white (water)	3	99
Clay, red, with little iron ore	4	103
Sand and clay, white; gravel at 119 feet	16	119
2S2E-1		
Arundel and Patuxent formations:		
Topsoil, clay, sand, etc	73	73
Sand	10	83
Clay, red, hard	26	109
Sand and gravel, in layers	37	146

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Clay, yellow, hard	26	172
Clay, sandy, hard	14	186
Clay, red	8	194
Pre-Cambrian rocks:		
Granite	2	196
2S2E-6		
Water	15	15
Recent deposits:		
Mud	13	28
Pleistocene (?) deposits:		
Sand, fine and coarse	8	36
Arundel clay:		
Clay, red, hard	10	46
Patuxent formation:		
Sand, white, fine, hard	48	94
Sand, coarse; some rocks	61	155
Gravel, fine, quartz; some rock	8	163
Pre-Cambrian rocks:		
Rock, rotten	27	190
Rock, shattered	5	195
Bedrock (granite, pegmatite)	17	212
2S2E-11		
Recent deposits:		
Fill	20	20
Yellow pine pile	10	30
Pleistocene deposits:		
Clay, yellow	10	40
Sand and gravel, coarse (brackish water)	5	45
Arundel and Patuxent formations:		
Clay, red	25	70
Gravel (water)	5	75
Clay, blue	25	100
Clay, micaceous; sand; hard rock at 142 feet.	42	142
2S2E-21		
Recent deposits:		
Fill	25	25
Mud, black	5	30
Pleistocene deposits:		
Clay, pinkish	12	42

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Sand and gravel (brackish water)	5	47
Arundel and Patuxent formations:		
Clay, variegated	48	95
Sand and gravel (water)	2	97
Clay, variegated; sand streaks	58	155
Gravel and sand (water)	2	157
Pre-Cambrian rocks:		
Rock, black, hard	160	317
2S2E-38		
Recent deposits:		
Soil	10	10
Arundel (?) clay:		
Clay, red	25	35
Patuxent formation:		
Sand, fine	10	45
Gravel (water)	3	48
(Not reported). Rock at 99 feet	51	99
2S3E-17		
Recent deposits:		
Fill	16	16
Mud, blue	14	30
Pleistocene deposits:		
Clay	15	45
Sand	5	50
Gravel, coarse	20	70
Gravel and sand	4	74
Patuxent formation:		
Sand, fine	26	100
Clay, white; hard slate	8	108
Sand	15	123
Clay, white, hard	19	142
Sand, medium	33	175
Clay	7	182
Gravel, coarse	23	205
Sand	1	206
Boulders, large	1	207
Pre-Cambrian rocks:		
Rock, flinty	11	218
2S3E-41		
Pleistocene deposits:		
Sand	18	18

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Gravel	1	19
Sand	26	45
Clay	2	47
Sand, with little clay	20	67
Sand and gravel, coarse (water)	2	69
Arundel and Patuxent formations:		
Sand, fine; occasional very thin gravel bed	101	170
Gravel, coarse, clean	28	198
2S3E-42		
Pleistocene deposits:		
Sand and gravel	7	7
Clay, white	22	29
Gravel; clay, yellow	9	38
Arundel clay:		
Clay, red	18	56
Patuxent formation:		
Sand; clay, white	18	74
Clay, yellow	6	80
Clay, light yellow	3	83
Clay, white	6	89
Clay, yellow	10	99
Sand, white	19	118
Clay, white	5	123
Sand, coarse	5	128
Clay, white	1	129
Clay, yellow	8	137
Clay, white; sand, and gravel	7	144
Sand, light	14	158
Clay, light	1	159
Sand, red	20	179
Sand, light red, coarse	1	180
Gravel, small	3	183
Gravel, sand, and clay	4	187
Clay	3	190
Gravel, coarse (water)	7	197
2S3E-61		
Pleistocene deposits:		
Clay, yellow	6	6
Arundel and Patuxent formations:		
Sand, white	70	76
Clay, red	6	82

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Sand, reddish	44	126
Clay, sandy, variegated	31	157
Clay, white	9	166
Sand and gravel	21	187
Pre-Cambrian rocks:		
Micaceous material, gray, carrying some garnetiferous material	13	200
2S3E-64		
Pleistocene deposits, Arundel and Patuxent formations:		
Clay, alternating strata	117	117
Sand	43	160
Clay	31	191
Sand	15	206
Clay, sandy	18	224
2S3E-65		
Pleistocene deposits, Arundel and Patuxent formations:		
(Not reported)	80	80
Water bearing	5	85
Clay, yellow	60	145
Sand and gravel grading to rock	90	235
2S4E-1		
Pleistocene deposits:		
Loam, sandy	12	12
Sand and gravel	18	30
Clay, sandy	25	55
Arundel clay:		
Clay, sandy, varicolored	30	85
Clay, brown, with sand	10	95
Clay, red and yellow, mixed with sand	15	110
Clay, yellow and brown, with varying amounts of sand	26	136
Patuxent formation:		
Sand, brown, with some clay	6	142
Sand, yellow, coarse	12	154
Sand, coarse, with gravel	3	157
Sand, brown	3	160
Sand and gravel, yellow, coarse	9	169
Sand, white, coarse	6	175

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Sand and gravel, coarse	3	178
Sand, reddish, with some clay	5	183
Clay, deep red	3	186
Clay, light red	4	190
Clay, gray	5	195
Clay, slate gray	10	205
Clay, yellow and brown, with little sand	20	225
Clay, hard, reddish, with sand	4	229
Sand and gravel, yellow, coarse	3	232
Gravel, coarse (water)	8	240
Gravel, coarse, with sand	6	246
Gravel and sand, white, coarse	11	257
Sand and clay, fine	10	267
Pre-Cambrian rocks:		
Clay, brown and yellow, hard; gneiss at 279 feet	12	279
2S4E-9		
Pleistocene deposits and Patapsco (?) formation:		
Sand	10	10
Clay, white	5	15
Sand	20	35
Arundel clay:		
Clay, red	55	90
Patuxent formation:		
Sand	2	92
Clay, blue	16	108
Sand, fine	5	113
Sand and gravel, coarse	103	216
Pre-Cambrian (?) rocks:		
Boulders	8	224
2S4E-10		
Pleistocene and Cretaceous sediments:		
Soil, sandy; clay	35	35
Clay, sandy	8	43
Sand	25	68
Boulders	1	69
Clay, sandy	40	109
Sand	7	116
Boulders	1	117
Sand	43	160
Clay	2	162

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Sand	4	166
Clay	25	191
Sand	38	229
2S4E-11		
Recent, Pleistocene, and Cretaceous sediments:		
Clay and fill	83	83
Clay, sandy	10	93
Sand	40	133
Clay	12	145
Sand	11	156
Clay	3	159
Sand	15	174
Clay	10	184
Sand	40	224
2S4E-12		
Pleistocene deposits and Patapsco (?) formation:		
Clay, red	8	8
Sand, brown, fine	13	21
Clay, sandy, soft	25	46
Arundel clay:		
Clay, red, hard	10	56
Sandstone	1	57
Clay, soft	9	66
Sand, gray	2	68
Clay, sandy, soft	30	98
Clay, red, hard, hard drilling	7	105
Patuxent formation:		
Sand, brown	1.5	106.5
Clay, blue, hard	2.5	109
Sand, gray, coarse	2	111
Clay, sandy, soft	10	121
Clay, red, very hard	5	126
Sand, brown, coarse	2	128
Clay, red, very hard	29	157
Sand, gray, coarse	3	160
Clay, red, very hard	9	169
Sand, gray, coarse, very sharp	7	176
Clay, red, hard	8	184
Sandstone	1	185
Sand, gray, coarse; gravel	17	202

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Pre-Cambrian rocks:		
Clay, blue, hard	14	216
Rock, honeycombed; ledge at 223 feet	7	223
3S1E-3		
Recent deposits:		
Cinder fill	20	20
Pleistocene deposits:		
Sand, gray, fine	7	27
Arundel clay:		
Clay, red, tough, hard drilling	37	64
Patuxent formation:		
Sandstone, hard	3	67
Sand, fine	2	69
Clay, red, tough, hard drilling	68	137
Sand, gravel, boulders, clay	19	156
Clay, blue	8	164
3S1E-4		
Recent deposits:		
Fill	50	50
Pleistocene deposits:		
Gravel, "river bed"	19	69
Arundel and Patuxent formations:		
Clay and marls, variegated	73	142
Sandrock, red, soft, crumbling (water)	25	167
3S1E-15		
Recent deposits:		
Cinders	4	4
Pleistocene deposits:		
Sand, muddy	18	22
Arundel clay:		
Clay, red, hard	26	48
Clay, red	9	57
Patuxent formation:		
Clay, sandy	6	63
Sand, white, fine	11	74
Clay, hard	11	85
Sand, muddy	9	94
Sand, white, fine	6	100
Clay, red	26	126
Sand, muddy	6	132

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Sand, white	16	148
Sand and gravel, coarse; hard rock at 179 feet	31	179
3S1E-16		
Recent (?) deposits:		
Clay, red	10	10
"Brick"	4	14
Arundel clay:		
Clay, red, tough	18	32
Clay	18	50
Patuxent formation:		
Sand, muddy	10	60
Sand, packed	12	72
Sand, muddy	11	83
Clay, red, tough	22	105
Sand, muddy	11	116
Clay, tough	9	125
Sand, muddy	7	132
Sand and gravel	3	135
Sand and gravel, coarse (water); hard rock at 170 feet	35	170
3S2E-1		
Pleistocene (?) deposits:		
Sand, yellow	4	4
Arundel clay:		
Clay, light-colored	15	19
Sandstone, red	1	20
Clay, lead-colored, with nodules of carbonate of iron	28	48
Patuxent formation:		
Clay, sandy	2	50
Sand, white	6	56
Clay, light-colored	12	68
Clay, chocolate-colored	9	77
Clay, light blue	33	110
Clay, sandy, yellow	7	117
Clay, lead-colored, with lignite	13	130
Clay, pink	6	136
Red ochre, the lower part very hard	2	138
Sand, white	7	145

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
3S3E-26		
Water	23.5	23.5
Pleistocene deposits:		
Mud, semiliquid	12	35.5
Silt, soft	24	59.5
Sand, gray, medium; some gravel	2	61.5
Sand, gray, coarse; gravel	3	64.5
Soft stratum (sample unobtainable)	1.5	66
Clay, medium brown and gray; some sand	4.5	70.5
Sand, medium brown	8	78.5
Sand and gravel, brown, coarse	.5	79
3S3E-27		
Water	25.5	25.5
Pleistocene deposits:		
Mud, semiliquid	10	35.5
Silt, soft	35.5	71
Sand and gravel, brown, coarse	7.5	78.5
3S3E-28		
Water	27.5	27.5
Pleistocene deposits:		
Mud, semiliquid	16	43.5
Silt, soft	36.5	80
Sand and gravel, brown and gray, coarse	2	82
Patapsco (?) formation:		
Clay, sandy, fine, hard	3	85
3S3E-29		
Water	26.5	26.5
Pleistocene deposits:		
Mud, semiliquid	15	41.5
Silt, soft	39	80.5
Sand, gray, coarse	5	85.5
Patapsco (?) formation:		
Sand, silty, coarse	4	89.5
3S3E-30		
Water	26	26
Pleistocene deposits:		
Mud, semiliquid	17.5	43.5
Silt, soft	40	83.5
Sand, gray, coarse	5	88.5
3S3E-31		
Water	36	36
Pleistocene deposits:		
Mud, semiliquid	14.5	50.5

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Silt, soft	30	80.5
Sand, gray, coarse	6.5	87
3S3E-32		
Water	41	41
Pleistocene deposits:		
Mud, semiliquid	9.5	50.5
Silt, soft	34	84.5
Sand and gravel, gray, coarse	5	89.5
3S3E-33		
Water	38.5	38.5
Pleistocene deposits:		
Mud, semiliquid	13	51.5
Silt, soft	28	79.5
Sand and gravel, silty, coarse	5	84.5
3S3E-34		
Recent deposits:		
Fill	14	14
Arundel clay:		
Clay, red, tough	19	33
Clay, drab, tough	22	55
Clay, brown, tough	9	64
Clay, red, tough	24	88
Clay, red, hard	13	101
Patuxent formation:		
Clay, sandy, pink, very hard	5	106
Sand, white, free	19	125
Streaks of clay, red, hard	2	127
Sand, white, not free	6	133
Sand, white, free	13	146
Clay, red, tough	3	149
Clay, sandy, red	9	158
Sand, white, free	8	166
Clay, sandy, red, hard	2	168
Clay, yellow, tough	3	171
3S4E-1		
Pleistocene and Cretaceous sediments:		
Surface soil, sand and clay	37	37
Rock, hard	1	38
Clay, varicolored	204	242
Sand, fine, clean (little water)	16	258
Trap rock, hard	2	260
Sand, fine, clean (water)	31	291
(Not reported)	21	312

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
3S4E-2		
Recent and Pleistocene deposits:		
Fill	3	3
Clay	4	7
Sand, white	11	18
Patapsco formation:		
Clay, red	36	54
Clay, sandy	11	65
Clay, blue	25	90
Sand, fine	18	108
Arundel clay:		
Clay, "buckshot"	84	192
Patuxent formation:		
Clay, red, soft	22	214
Clay, hard	26	240
Clay, brown	20	260
Clay, red	6	266
Sand and gravel	38	304
Clay, red	9	313
3S5E-11		
(Not reported)	8	8
Pleistocene deposits and Patapsco formation:		
Sand, clay, gravel	94	102
Patapsco formation:		
Clay, red, hard	15	117
Clay, sandy, yellow, hard	34	151
Sand and gravel, hard	10	161
Sand, brown, fine	16	177
Sand and gravel	4	181
Arundel clay:		
Soapstone, hard	19	200
Sand, hard	2	202
Clay, red, soft	5	207
Hardpan	16	223
Patuxent formation:		
Sand, hard	10	233
Clay	4	237
Sand and gravel	21	258
Clay	4	262
Sand and gravel	39	301

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
3S5E-15		
Pleistocene deposits:		
River mud	50	50
Sand	20	70
Patapsco formation:		
Clay, red	38	108
Sandy	4	112
Clay, hard sand with clay	33	145
Boulder	1	146
(Not reported)	11.6	157.6
Boulder	1	158.6
Sand	9.4	168
Arundel clay:		
Hard	42	210
Clay, soft, with little sand	20	230
Clay; boulder 2 inches thick	6	236
Patuxent formation:		
Sand and clay	4	240
Sand	29.5	269.5
Clay	5.3	274.8
Free with gravel	8	282.8
Hard place (like clay)	7.2	290
(Not reported)	48	338
3S5E-22		
Cretaceous sediments:		
Clay, red, hard	140	140
Gravel (water)	10	150
3S5E-30		
Pleistocene deposits:		
(Not reported)	15	15
Clay, brown and gray	6	21
Patapsco formation:		
Clay, red	12	33
Clay, red, softer	2	35
Clay, red, little sandy	2	37
Clay, gray	2	39
Clay, gray, soft	2	41
Clay, sandy, gray	8	49
Clay, gray	2	51
Sandy	2	53
Rock, hard	2	55

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Sandy	3	58
Sand	4	62
Sand and gravel; hard crust at 72 feet	12	74
Clay, red	2	76
Clay, gray	21	97
Clay, red and white	2	99
Clay, red and white; rock 4½ inches thick at 100 feet	2	101
Clay, sandy, white	4	105
Clay, white and red	2	107
Sand and gravel, white	2	109
Sand	6	115
Sand, white	7	122
Sand, white; clay streaks	4	126
Sand, white	6	132
Sand, coarse	6	138
Sand, brown and white, coarse	4	142
Gravel	5	147
Arundel clay:		
Rock	.2	147.2
(Not reported)	.8	148
Clay, red	27	175
Clay, light brown, softer	2	177
Clay, gray	2	179
Clay, dark gray	2	181
Clay, dark gray, tough	2	183
Clay, gray	11	194
Clay, brown	2	196
Clay, dark gray	2	198
Clay, red	4	202
Clay, gray	6	208
Clay, very red	6	214
Patuxent formation:		
Sand	2	216
Sand, free in places	2	218
Boulder (below red sandy clay)	2	220
Clay, sandy, brown	4	224
Clay, sandy, gray	2	226
Clay, sandy, white	11	237
Clay	4	241
Sand	2	243
Sand and gravel	4	247
Gravel	2	249

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Sand and gravel	2	251
Sand and gravel; streak of clay	2	253
Sand and gravel; hard place at 264 feet	12	265
Gravel; streaks of clay	6	271
Clay, sandy, white	3	274
Clay, sandy, pink and white	2	276
Clay, sandy, white (tight)	2	278
Sand and gravel; clay streaks	1	279
Sand and gravel, free	1	280
Sand, free	4	284
Sand	2	286
Sand; clay streaks	2	288
Sand	2	290
Sand, coarse	4	294
Sand, white, free	2	296
Sand; clay streak	2	298
Sand	1	299
Sand, coarse, free	1	300
Clay, sandy	1	301
Sand, coarse, free	1	302
Sand and gravel, very free; clay streak	2	304
Gravel, free; sandy clay streaks	2	306
Gravel, free	2	308
Sand and gravel; clay streaks	2	310
Clay, sandy	4	314
Clay	1	315
Gravel	1	316
Sand and gravel, red, free	5	321
Sand, red, coarse, free; clay streaks	4	325
Sand, free; clay	2	327
Clay, pink and white	2	329
Clay, sandy, white	4	333
Clay, gray; wood	8	341
Clay, light gray	2	343
Clay, white and pink	4	347
Clay	2	349
Sand and gravel, free	2	351
Sand, coarse, free	4	355
Clay, light; gravel	2	357
Clay, white, hard	2	359
Clay, white	2	361
Clay and gravel	3	364
Gravel	2	366

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Gravel and some clay	2	368
Gravel	22	390
Rock	1	391
Clay, white, hard	1	392
Clay, white	2	394
3S5E-31		
Pleistocene deposits:		
Sand and gravel	15	15
Mud, blue	25	40
Sand and gravel	38	78
Patapsco formation:		
Clay, blue	8	86
Clay, reddish brown	6	92
Clay, red and white	24	116
Clay, very hard	1	117
Clay, white	6	123
Clay, varicolored	25	148
Clay, white; sand and gravel	24	172
Clay, red; sand and gravel	7	179
Arundel clay:		
Clay, red	31	210
Clay, sandy, red	13	223
Clay, very hard	.5	223.5
Clay, sandy, red	36.5	260
Patuxent formation:		
Sand and gravel; streaks of clay	11	271
Sand and gravel (water)	15	286
Clay, white	6	292
Clay, white; sand and gravel	9	301
Clay, sandy, white; gravel	31	332
Clay, sandy, white and red; gravel	9	341
Clay, red	8	349
Clay, blue; sandy streaks; little gravel	10	359
Clay, sandy, white	21	380
Clay, sandy, white; some gravel	11	391
Sand and gravel (water)	24	415
Gravel; clay, colored	18	433
Pre-Cambrian rocks:		
Granite	3	436
4S2E-2		
Recent deposits:		
Fill	8	8

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Pleistocene deposits:		
Sand and gravel	32	40
Arundel clay:		
Clay, dark	5	45
Clay, red	45	90
Rock and clay	.8	90.8
Patuxent formation:		
Sand, fine; clay	21.2	112
Rock	.3	112.3
Clay, brown; sand, fine; mixed with thin rock	25.7	138
Sand, fine; clay	38	176
Sand and clay (water)	14	190
Sand (water); clay, hard packed, with thin layers of sandstone	20	210
Sand, fine; thin layers of blue marl	20	230
Sandstone, hard layer (water)	.3	230.3
Sand, coarse, with layers of sandstone about every 3 feet	21.7	252
Sand and clay; gravel, coarse	10	262
Sand	4	266
Clay; rock at 293 feet	27	293

4S3E-3		
Recent deposits:		
Fill, brick, etc	8	8
Pleistocene deposits and Patapsco formation:		
Sand, fine, soft	20	28
Mud, blue	85	113
Sand	2	115
Arundel clay:		
Clay, blue and red, hard	8	123
Clay, red, hard; few streaks of rock	52	175
Rock, hard	2	177
Clay, blue	15	192
Clay, hard	10	202
Patuxent formation:		
Clay, blue, soft	39	241
Clay, red and blue	51	292
Sand (water); little clay in the first 5 feet	33	325
Clay	8	333
Clay, blue, very hard	24	357

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
4S3E-4		
Pleistocene deposits and Patapsco formation:		
Sand	30	30
Clay, blue	8	38
Sand and gravel	24	62
Mud, blue	12	74
Gravel	10	84
Clay, blue	11	95
Arundel clay:		
Clay, red	80	175
Patuxent formation:		
Clay, sandy	9	184
Clay, white; sand	10	194
Sand (water)	27	221
Sand, some coarser than above (water)	12	233
Clay, red, very hard	1	234
4S3E-10		
Water	3.5	3.5
Recent deposits:		
Fill	12	15.5
Pleistocene deposits:		
Sand, gray, coarse; gravel	5	20.5
4S3E-11		
Water	22	22
Pleistocene deposits:		
Mud, soft; sand	7.5	29.5
Sand, brown and gray, fine; some clay	2	31.5
Sand and gravel, brown and gray, coarse	4	35.5
Clay, brown and gray, soft	1.5	37
Peat, sandy, soft; mica	3.5	40.5
Sand, brown and gray, fine; clay and mica	6	46.5
Peat, sandy; mica	2	48.5
Sand, gray, fine; mica	3	51.5
4S3E-12		
Water	23	23
Pleistocene deposits:		
Mud, semiliquid	17.5	40.5
Silt, soft	29	69.5
Sand and gravel, gray, coarse	7	76.5

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
4S3E-13		
Water	25	25
Pleistocene deposits:		
Silt, semiliquid	15.5	40.5
Silt, soft	35	75.5
Sand and gravel, gray, coarse	4	79.5
Sand and gravel, brown, coarse	1	80.5
4S3E-14		
Water	38.5	38.5
Pleistocene deposits:		
Mud, semiliquid	10	48.5
Silt, soft	28	76.5
Sand, brown and gray, fine; some clay	3	79.5
Shale, brown	2	81.5
5S2E-2		
Pleistocene and Cretaceous sediments:		
(Not reported)	103	103
Cretaceous sediments:		
Clay, red	10	113
Clay, sandy, white	41	154
Clay, white, hard	14.5	168.5
Clay, white, soft	15	183.5
Sand and gravel, free	1.5	185
(Not reported)	.5	185.5
Clay, sandy, white	9.5	195
Clay, red and white	2	197
Sand	2	199
Sand, brown; gravel, fine	24	223
Clay, sandy, white; gravel	6	229
Clay, red and white	9	238
Sand; gravel, fine	12	250
Sand	2	252
Clay, sandy, white	17	269
Clay, red	8	277
Clay, gray	6	283
Clay, red	15	298
Clay, gray	4	302
Clay, red	4	306
Clay, white	4	310
Clay, gray	10	320
Sand	1	321

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Gravel, free	4	325
Gravel, light	2	327
5S2E-8		
Pleistocene deposits:		
Clay	7	7
Sand	48	55
Patapsco formation:		
Clay, white, tough	6	61
Sand and gravel, coarse	9	70
Sand and clay, white, mixed	34	104
Sand, coarse, white on top, pink on bottom	18	122
5S2E-13		
Pleistocene deposits:		
Clay, yellow, dry	10	10
Sand, yellow, dry	20	30
Sand, yellow, coarse	10	40
Patapsco formation:		
Clay, white, dry	2	42
5S2E-14		
Pleistocene deposits:		
Clay, yellow	10	10
Sand, brown and yellow; coarse sand and gravel at 36 feet	26	36
5S2E-20		
Pleistocene deposits:		
Mud, gray; wood	52	52
Gravel and clay; iron ore streaks	6	58
Patapsco formation:		
Clay, white, streak brown	4	62
Clay, white, hard	2	64
Clay, white	4	68
Clay, sandy, white and pink	7	75
Gravel, free	1	76
Sand, free	2	78
Sand	6	84
Sand, free	4	88
Arundel clay:		
Clay, white and red	2	90
Clay, red	4	94

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Clay, white and pink	5	99
Clay, white	2	101
Clay, white and red	2	103
Clay, red	4	107
Clay, white and pink	4	111
Clay, brown and pink	2	113
Patuxent formation:		
Crusty	2	115
Sand, free	5	120
Sand, white	9	129
Clay, sandy, white	6	135
Sand, white	4	139
Clay, white	2	141
Sand	1	142
Clay, sandy, white	3	145
Sand, white	4	149
Sand, coarse	2	151
Clay, white	6	157
Clay, sandy, white	2	159
Sand	2	161
Clay	2	163
Sand	2	165
Clay, sandy, white	3	168
Clay, white	1	169
Sand	2	171
Clay, white	3	174
Clay, red	4	178
Clay, sandy	4	182
Sand	2	184
Clay, sandy, brown and white	2	186
Sand	1	187
Clay, white	8	195
Clay, sandy, white	8	203
Sand	7	210
Clay, sandy	11	221
Gravel, free; sand, coarse	2	223
Sand and gravel	9	232
Gravel	2	234
Clay	2	236
Sand and clay	4	240
Clay and gravel	2	242
Sand, fine	2	244
Clay, sandy	2	246

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Sand, red	10	256
Sand and gravel, red	4	260
Sand, red	2	262
Sand	2	264
Clay, gray	2	266
Clay, red, hard	4	270
Sand and gravel	6	276
Sand and gravel, free	1	277
Sand, clay, and gravel	4	281
Sand and clay	2	283
Clay, gray	2	285
Clay, sandy, gray	2	287
Clay, sandy	8	295
Clay	2	297
Clay, pink	2	299
Clay, gray	1	300
5S3E-2		
Pleistocene deposits:		
(Not reported)	16	16
Sand, yellow and gray	19	35
Gravel, large	5	40
Patapsco formation:		
Sand, white	14	54
Clay, white, tough, streaked with sand	6	60
Sand, white, free	6	66
Clay, sandy, white	10.9	76.9
Sand, white, free	3.1	80
Arundel clay:		
Hard place	77.5	157.5
Patuxent formation:		
Sand	24.5	182
Crust; then free sand, some coarse	31	213
Clay, sandy	3	216
Clay, white, hard	2	218
Sand, white, free	6	224
Clay, sandy	2	226
Clay, hard	1	227
Clay	15	242
Sand with some very coarse gravel	1	243
Clay	6	249
Gravel, free	9	258
Clay, white, hard	3	261

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Sand, free	8.7	269.7
Clay and sand streaks	1.3	271
Clay, hard	5	276
Clay, white, softer	30	306
5S3E-12		
Pleistocene deposits:		
(Not reported)	20	20
Clay	20	40
Gravel	24	64
Cretaceous sediments:		
Clay, hard	2	66
Sand	14	80
Clay, hard	12.5	92.5
Sandy, free; hard sand at 94.7 feet	2.2	94.7
Sand, free	16.3	111
Sand, hard	16.4	127.4
Sand, softer	40.9	168.3
Clay, hard	3	171.3
Iron ore, hard	7.7	179
Sand, not free	1	180
Hard	19	199
Sandy, free in places	11	210
Hard place	5	215
Sandy, not free	22.8	237.8
Harder	11	248.8
Sand, yellow, free	4.8	253.6
Sand, red, free	.1	253.7
Iron ore, hard	4.3	258
Clay	9.3	267.3
Sand and gravel	.7	268
Iron ore, hard	1.6	269.6
Sand and gravel	4.4	274
Iron ore, hard	16	290
Sand, not so free	14	304
Clay, hard	1	305
Clay, sandy	13	318
Clay, blue	16	334
Sand	10	344
Sand, free in places	10	354
Gravel	2	356
Pre-Cambrian rocks:		
Clay in streaks; bedrock at 361 feet	5	361

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
5S3E-17		
Pleistocene deposits:		
Clay, yellow, soft	15	15
Mud, black, soft	13	28
Sand, white, soft	7	35
Clay, sandy, white, soft	10	45
Gravel, white, soft	14	59
Patapsco formation:		
Clay, reddish, soft	4	63
Clay, sandy, white, soft	4	67
Gravel, white, soft	23	90
Sand, white, soft	12	102
Clay, red-white, hard	5	107
Clay, sandy, with iron ore, hard and soft	3	110
Sand, coarse, with iron ore, soft	5	115
Clay, white, hard	4	119
Sandy, red, free	4	123
Clay, white, hard	5	128
Sand and clay, white, free	7	135
Sand, white, free	5	140
Sandstone, white, hard	8	148
Arundel clay:		
Clay, drab, tough	20	168
Clay, drab, hard	2	170
Clay, drab, soft	9.3	179.3
Boulder, hard	1	180.3
Clay, drab, soft	6.6	186.9
Boulder, hard	.2	187.1
Clay, drab, soft and hard	20.9	208
Patuxent formation:		
Sand	17	225
Clay, drab, soft	3	228
Clay, sandy, white, soft	20	248
Sand, red, free	17	265
Clay, sandy, white, soft	28	293
Sand, red, free	14	307
Clay, white, soft	25	332
Clay, sandy, white, soft	35	367
Gravel	6	373
Gravel, white, soft	14	387
Pre-Cambrian rocks:		
Clay, yellow, soft; rock at 391.6 feet	4.6	391.6

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
5S3E-21		
Pleistocene deposits and Patapsco formation:		
Clay, blue	6.2	6.2
Sand	15.8	22
Gravel	11	33
Clay and gravel	10	43
Sand and gravel	42	85
Clay	5	90
Sand and gravel	8	98
Clay	4	102
Clay, sandy	49	151
Arundel and Patuxent formations:		
Clay, red	37	188
Clay, sandy	27	215
Boulder	1	216
Clay	27.6	243.6
Boulder	.3	243.9
Clay	36.1	280
Boulder	.7	280.7
Clay	1.8	282.5
Clay, sandy	7	289.5
Clay, hard	.5	290
Sandy	28	318
Clay	3	321
Boulder	.2	321.2
Clay	32.8	354
Clay, sandy	22	376
Sand and gravel	17	393
Pre-Cambrian rocks:		
Bedrock	3	396

	Thickness (feet)	Depth (feet)
5S3E-32		
Pleistocene deposits and Patapsco formation:		
Sand	16	16
Clay, blue	47	63
Gravel	34	97
Arundel clay:		
Clay, red, hard	36.8	133.8
Iron ore, hard	.2	134
Clay, red and brown	4.9	138.9
Hard place	.3	139.2
Clay	3.2	142.4
Hard place	.2	142.6

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Clay	3.5	146.1
Iron ore	.2	146.3
Clay	4.8	151.1
Iron ore, hard	.3	151.4
Clay	17.6	169
Patuxent formation:		
Sand and wood	1	170
Hard	.5	170.5
Sandy	3	173.5
Iron ore, hard	2.5	176
Soft	2	178
Hard	2	180
Sand	7	187
Clay, red and pink	10	197
Sand, free; hard places	26	223
Clay, red	12	235
Sand; hard places	49	284
Clay, hard	32	316
(Not reported)	36	352
5S3E-33		
Pleistocene deposits:		
Sand	15	15
Clay, blue	50	65
Sand and gravel (little brackish water)	4	69
Clay, black	12	81
Patapsco formation:		
Clay, red	5	86
Sand (little brackish water)	13	99
Arundel clay:		
Clay, red	8	107
Clay, gray	40.9	147.9
Iron ore	2	149.9
Patuxent formation:		
Sand and gravel (water)	38.8	188.7
Clay	14.1	202.8
Sandy	4.2	207
Sand (water)	59	266
Sand, yellow	20.3	286.3
Iron ore	.7	287
Clay, white	15.8	302.8
Clay, red	10	312.8
Clay, sandy	13.8	326.6

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Gravel	2.4	329
Clay	5	334
Gravel	21	355
5S3E-35		
Pleistocene deposits and Patapsco formation:		
Gravel	62.3	62.3
Clay, in streaks	33.7	96
Clay, sandy	1	97
Arundel clay:		
Clay, red and blue	44.8	141.8
(Not reported)	8.2	150
Boulder	.2	150.2
(Not reported)	14.8	165
Hard place	.2	165.2
Patuxent formation:		
Sandy and wood	8.8	174
Hard	.6	174.6
(Not reported)	3	177.6
Boulder	.3	177.9
Soft	24.1	202
Boulder	.3	202.3
Clay	6.7	209
Boulder	.3	209.3
Sandy	18.5	227.8
Clay, hard	23.5	251.3
Hard place	.2	251.5
Sand and gravel	20.5	272
Clay and iron ore	1.5	273.5
Clay, hard	32.5	306
Soft	8	314
Gravel	29.8	343.8
Pre-Cambrian rocks:		
Rock	.8	344.6
5S3E-36		
Pleistocene deposits:		
Clay	45	45
Gravel	3	48
Patapsco formation:		
Clay, sandy	21	69
Sand, free	15	84

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Arundel clay:		
Clay, tough	58	142
Patuxent formation:		
Sandy	5.4	147.4
Granite, hard; clay at 148.8 feet	1.4	148.8
(Not reported)	41.2	190
Clay, tough	12	202
Sand and gravel	14	216
Clay, tough	34.8	250.8
Hard	1	251.8
Sand and gravel	4	255.8
Sand; some clay streaks	4	259.8
Clay streaks; some sand and gravel	9.2	269
(Not reported)	21	290
Sandy; hard at 297.5 feet	7.5	297.5
Sand	5	302.5
Sandy	12.5	315
Hard place	.5	315.5
Sand and gravel, free in places	12.5	328
Clay, sandy	6	334
Sandy, almost free	3	337
Pre-Cambrian rocks:		
Clay; rock at 344 feet	7	344

	Thickness (feet)	Depth (feet)
5S3E-45		
Pleistocene deposits:		
(Not reported)	26	26
Gravel, coarse	4	30
Clay, blue	20	50
Patapsco formation:		
Sand	20	70
Clay	22	92
Sand (water)	24	116
Arundel clay:		
Clay, sandy; iron strata	24	140
Clay, red, hard	10	150
Patuxent formation:		
Sand	12	162
Clay, blue	17	179
Boulder	2	181
Clay, brown	25	206
Clay, hard; iron crust	23	229
Boulder	1	230

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Clay, sandy	14	244
Sand (water)	11	255
Clay, white	4	259
Sand (water)	30	289
Clay	41	330
Clay, sandy	12	342
Sand (water)	9	351
Clay, white	5	356
Sand and gravel, coarse (water)	25	381

	Thickness (feet)	Depth (feet)
5S3E-46		
Pleistocene deposits:		
Clay, sandy, brown	10	10
Clay, brown, tough	5	15
Clay, blue	5	20
Sand and gravel	25	45
Patapsco formation:		
Clay, red and white	8	53
Clay, red	3	56
Clay, white	8	64
Clay, sandy, white	2	66
Clay, red and white	2	68
Clay, sandy, white	5	73
Gravel	1.5	74.5
Clay, white	2	76.5
Clay, sandy, white	8	84.5
Sand	11	95.5
Clay, sandy	1.5	97
Sand	9.5	106.5
Arundel clay:		
Clay	11.5	118
Sand; 6 inches of clay at bottom	1.5	119.5
Clay	4	123.5
Clay, sandy	4	127.5
Clay, red	12	139.5
Clay, white	1	140.5
Clay, red and white	17.5	158
Patuxent formation:		
Sandy	5	163
Clay, white	1.5	164.5
Clay, sandy (last 6 inches hard)	6	170.5
Clay, sandy	20.5	191
Sand and gravel	2	193

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Gravel	6	199
Clay streaks	2	201
Sand and gravel	7	208
Sand, some coarse	5.5	213.5
Clay, sandy, white	4	217.5
Sand	2	219.5
Clay, sandy, white	6	225.5
Sand and gravel	4	229.5
Mixed with clay	2.5	232
Clay, red	2	234
Clay, red and brown, with gravel	4	238
Sand	3.5	241.5
Clay, red and white	3	244.5
Clay, sandy, white	2	246.5
Clay, white	4	250.5
Clay, red and white	2	252.5
Sand, red	6	258.5
Sand and gravel, brown and white	12	270.5
Sand, brown, coarse, few clay streaks	15	285.5
Clay, sandy, white and pink	10	295.5
Clay, sandy, pink	1	296.5
Clay, sandy, white	21.5	318
Clay, tough	1	319
Clay, red and white	1.5	320.5
Clay, white	4	324.5
Clay, sandy, white	2	326.5
Clay, white	6	332.5
Clay, white and red	11.5	344
Sand, coarse	1	345
Sand and gravel, coarse	2	347
Gravel; clay, red and white	1	348
Gravel	14	362
Clay, crusty, brown; iron ore	1	363
Clay and gravel, light brown	1	364

6S2E-1		
Pleistocene deposits:		
Sand, clay, and gravel	44	44
Sand, free	21	65
Gravel and sand	4	69
Patapsco formation:		
Clay	1	70
Sand	2	72

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Clay	.5	72.5
Gravel, fine	4.5	77
Clay, hard	7.5	84.5
Clay, sandy	1	85.5
Sand, free	3	88.5
Clay, hard	4	92.5
Sand, free	11.5	104
Clay, sandy	1	105
Sand	2	107
Clay, sandy	9	116
Sand, free	6.5	122.5
Clay	1	123.5
Clay, sandy	6	129.5
Arundel clay:		
Clay, red, hard	19.2	148.7
Clay, sandy	11	159.7
Clay	6.6	166.3
Clay, red, hard	8	174.3
Patuxent formation:		
Clay, sandy	12.7	187
Sand	6	193
Rock	.3	193.3
Sand	.6	193.9
Rock	.1	194
Sand	2	196
Clay, sandy	6	202
Rock	.1	202.1
Sand	.4	202.5
Rock, crusty	1.8	204.3
Clay	.5	204.8
Rock	2.2	207
Sand	2	209
Rock, hard	.4	209.4
Rock, softer, crusty	1.6	211
Sand, free	3.8	214.8
Crusty	.7	215.5
Sandy	11.5	227
Sand, free	16	243
Sandy	12.4	255.4
Sand, free	19.3	274.7
Rock	.7	275.4
Gravel, free	4.7	280.1
Clay	.2	280.3

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Gravel, free	7.7	288
Sand, free	11	299
Clay, red, hard	1.5	300.5
6S2E-3		
Pleistocene deposits:		
Earth, mixed	10	10
Sand and gravel	67	77
Patapsco formation:		
Clay, hard	11	88
Clay, sandy	10	98
Clay, white	6	104
Sand	17	121
Clay	1	122
Sand	3	125
Clay	1	126
Sand	1	127
Clay, white	5	132
Arundel clay:		
Boulder	5	137
Clay, red	5	142
Sand	1	143
Clay, red	34	177
Boulder	1	178
Clay, gray	14	192
Boulder	2	194
Clay	6	200
Patuxent formation:		
Sand (water)	38	238
Clay	3	241
Sand	54	295
Clay	2	297
Sand	2	299
Clay, sandy	9	308
Clay	4	312
Sand (water)	24	336
Clay	1	337
Sand	14	351
Clay	3	354
Clay, sandy	4	358
Boulder	1	359
Clay, red	9	368
Wood and sand	2	370

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Clay, gray	3	373
Pre-Cambrian rocks:		
Granite and mica, soft	7	380
6S2E-4		
Pleistocene deposits and Patapsco formation:		
Hard	54	54
Sand, gravel, and clay	23	77
Clay, hard	13	90
Clay, sandy	21	111
Hard place	.2	111.2
Clay, sandy	21.8	133
Arundel clay:		
Very hard	5	138
Clay, hard	2	140
Hard	.5	140.5
"Streaky"	6.9	147.4
Clay	32	179.4
Hard boulder	1.8	181.2
Boulder	14	195.2
Patuxent formation:		
Clay, sandy	2.8	198
Sand	29	227
6S2E-5		
Pleistocene deposits:		
Earth, mixed	10	10
Sand and gravel	47	57
Patapsco formation:		
Clay	9	66
Clay, sandy	12	78
Clay, hard	11	89
Clay, sandy	10	99
Clay, white	4	103
Sand (water)	19	122
Clay, white	10	132
Arundel clay:		
Clay, red; some iron	10	142
Clay, red	36	178
Boulder	.4	178.4
Clay, gray	14.9	193.3
Boulder	.7	194
Clay, red	2	196

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Patuxent formation:		
Sand	32	228
Clay	16	244
Sand (water)	51	295
6S2E-6		
Pleistocene deposits and Patapsco formation:		
Earth, mixed	10	10
Gravel	11	21
Clay, white, hard	12	33
Gravel	18	51
Boulder	1	52
Clay, white	10	62
Sand and gravel	5	67
Clay, sandy, white	7	74
Clay, white	5	79
Clay, sandy, hard	2	81
Clay, sandy, white	18	99
Sand, white (water)	23	122
Clay, white	15	137
Arundel clay:		
Clay, red	6	143
Clay, gray	6	149
Clay, red	27	176
(Not reported)	.3	176.3
Boulder	.5	176.8
Clay, gray	15.3	192.1
Boulder	.9	193
Clay, red	2	195
Patuxent formation:		
Sand and gravel (water)	33	228
6S2E-7		
Pleistocene deposits and Patapsco formation:		
Earth, mixed	26	26
Clay	8	34
Sand and gravel	19	53
Clay, white	1	54
Sand and gravel	13	67
Clay, white	5	72
Sand	6	78
Sand with hard clay	2	80
Sand and gravel (water)	16	96

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Clay	6	102
Sand (water)	18	120
Clay and sand	6	126
Arundel clay:		
Clay	1	127
Clay, red	7	134
Clay, sandy	4	138
Clay, red	6	144
Clay, gray	5	149
Stone	31	180
Clay	10	190
Stone	1	191
Clay	3	194
Stone	2.5	196.5
Clay	3.5	200
Patuxent formation:		
Sand and clay	19	219
Sand (water)	25	244
Clay	8	252
Clay, sandy	6	258
Sand	26	284
Sand (water)	15	299
Clay	2	301
Sand	5	306
Clay	5	311
(Not reported) (water)	25	336
6S2E-10		
Pleistocene deposits and Patapsco formation:		
(Not reported)	38	38
Clay	1	39
Sandy	1	40
Sand and clay	25	65
Clay	2	67
Gravel, coarse	23	90
Sandy	13	103
Sand, reddish, free	15	118
Sand, fine	5.8	123.8
Clay	7.2	131
Sand, free	10.2	141.2
Clay	2.6	143.8

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
6S2E-14		
Pleistocene and Cretaceous sediments:		
Sand and gravel	5	5
Sand	20	25
Clay	35	60
Sand	8	68
Clay	16	84
Clay, sandy	27	111
Clay	1	112
Sand	22	134
Clay, sandy	24	158
Sand	6	164
Sand (water)	9	173
Clay, red	7	180
Clay, sandy	29	209
Sand	19	228
Clay	6	234
Clay, sandy	26	260
Gravel	2	262
Clay, sandy	10	272
Sand (water)	26	298
Clay, sandy	4	302
Sand, white (water)	10.5	312.5
Clay, sandy, white, hard	4	316.5
Sand (water)	8.3	324.8
Clay	3	327.8
Sand, white	6.2	334
Clay	1	335
Sand, free	6.5	341.5
Clay, red	5.5	347
Clay with sand streaks	7	354
Clay, red, hard	3.5	357.5
Clay, gray and white; wood and sand streaks	28.5	386
Clay, white	9	395
Granite, soft; mica; some gravel	6	401
Pre-Cambrian rocks:		
Same formation without gravel, getting harder	24	425
Rock, quite hard	6	431

6S2E-19		
Pleistocene and Cretaceous sediments:		
(Not reported)	285	285
Clay, sandy, white	16	301

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Sand, white (water)	11.5	312.5
Clay, sandy, white, hard	4	316.5
Sand, white	8.2	324.7
Clay	3.1	327.8
Sand, white	6.2	334
Clay	1	335
Sand, free	6.5	341.5

	Thickness (feet)	Depth (feet)
6S2E-28		
Pleistocene deposits and Patapsco formation:		
Sand and gravel	15	15
Clay, sandy, white, fine	1	16
Sand and gravel	7	23
Clay, white	4	27
Sand, hard	22	49
Clay	25	74
Sand	10	84
Clay, red	24	108
Clay, sandy	14	122
Sand	15	137
Arundel clay:		
Clay, sandy	23	160
Clay, red	41.8	201.8
Patuxent formation:		
Clay, sandy	7.6	209.4
Rock	.5	209.9
(Not reported)	21.6	231.5
Rock	.8	232.3
Clay	3.3	235.6
Rock	.4	236
Clay, sandy	.7	236.7
Rock	1	237.7
Sand	.9	238.6
Clay, sandy	14.4	253
Rock	.3	253.3
Sand	2.1	255.4
Rock	.4	255.8
Clay with rocks	4.4	260.2
Clay, sandy	17.3	277.5
Clay, white	2	279.5
Clay, sandy	5.8	285.3
Sand, free	18.9	304.2
Clay, sandy	5.1	309.3

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
6S2E-31		
Pleistocene deposits:		
(Not reported)	15	15
Gravel	15	30
Clay and gravel	33	63
Patapsco formation:		
Clay	8	71
Sand	8	79
Clay	6	85
Sandy	10.5	95.5
Arundel clay:		
Clay	74.8	170.3
Boulder	.5	170.8
Clay	7.2	178
Boulder	.5	178.5
Clay	11.5	190
Patuxent formation:		
Sand	1	191
Clay with sand streaks	6	197
Clay; boulder at 200.4 feet	6	203
(Not reported)	3	206
Clay, hard	5.5	211.5
Rock, soft	2.5	214
Clay, hard	1	215
Clay with sand streaks	27	242
Clay	5	247
Soft	2	249
Clay, sandy	19	268
Sand, free	13	281
Sand and gravel	9	290
Sand, free	6	296
Clay, sandy	2	298
Sand, free	5.8	303.8
Clay	2	305.8
Sand, free	1.2	307
Clay, hard	1.5	308.5
Sand, free	3.5	312
Clay	1	313
Sand	14.5	327.5
Clay	3.5	331
Sand, free	5	336
Clay	2	338
Sand with clay streak	6	344

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
6S2E-32		
Pleistocene deposits:		
(Not reported)	15	15
Gravel	15	30
Clay and gravel	33	63
Patapsco formation:		
Clay, hard	5	68
Sand	4	72
Clay, white; gravel	10.5	82.5
Clay, white, hard	5.5	88
Sandy	5.5	93.5
Arundel clay:		
Clay, hard (seems more like hard sandstone)	15.5	109
Clay, sandy	16.5	125.5
Clay, hard and soft	14.8	140.3
Clay, hard	3.7	144
Clay, softer	8	152
Harder	21.4	173.4
Sandy	1.5	174.9
Rock, soft	.4	175.3
Patuxent formation:		
Sandy	9.2	184.5
Crust, hard	.1	184.6
Sand streaks, crusts iron ore, red	4.4	189
Clay, red, soft	9	198
Sandy	14	212
Clay	6	218
Sand, free; gravel	8	226
Clay, sandy, white	4	230
Clay, sandy	4	234
Sand and gravel	14	248
Clay, sandy	15	263
Sand	8	271
Sand, free	20	291
Sand, clayey	3.4	294.4
Sand	6.6	301
Clay, red	9	310
Clay, sandy	7	317
Gravel, fine	9.5	326.5
Sand and gravel, fine	12	338.5
Pre-Cambrian rocks:		
Rock	.1	338.6

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
6S2E-36		
Pleistocene deposits and Patapsco formation:		
Clay, yellow	12	12
Gravel	2	14
Clay	1	15
Gravel	5	20
Sand, coarse	18	38
Sand, fine	1	39
Clay	5.5	44.5
Sand, coarse	18.5	63
Clay	4	67
Sand, coarse	13	80
Clay	4	84
Sand, coarse (water)	39.5	123.5
Boulders	2	125.5
Clay	4	129.5
Sand, coarse	10	139.5
Arundel clay:		
Clay	6	145.5
Rock, hard	3	148.5
Clay, red, hard	36.5	185
Patuxent formation:		
Sand, coarse	3	188
Clay, red	3	191
Sand, coarse	6	197
Clay	7	204
Sand, coarse	40	244
Clay	17	261
Sand, coarse	10	271
Clay	5	276
Sand, coarse	19	295
Clay	3	298
Sand, coarse	12	310
Clay, red, tough	5	315

6S3E-2		
Pleistocene deposits:		
Clay	5	5
Clay, drab	20	25
Clay, hard	13	38
Sand and gravel	11	49
Patapsco formation:		
Clay, white, soft	15	64

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Sand, yellow	2	66
Clay, white	5	71
Sand, white	4	75
Clay	1	76
Clay, sandy	19	95
Sand, coarse, white	11	106
Clay, white, soft	4	110
Arundel clay:		
Clay, red, hard	1	111
Clay, pink and white, soft	10	121
Clay, brown, soft	4	125
Clay, pearl gray, soft	7	132
Clay, red	43	175
Clay, sandy, red	5	180
Clay, red, hard	15	195
Patuxent formation:		
Clay, sandy, drab	23	218
Clay, dull red, hard	5	223
Clay, bright red, hard	2	225
Sand, yellow, free	16	241
Clay, red, hard	3	244
Sand and rocks	12	256
Sand, white and yellow, free	18	274
Clay, red, hard	7	281
Sand and gravel, white	54	335
Iron ore, hard	2	337
Clay, red, hard	1	338
Clay, drab, soft	20	358
Iron ore, hard; sand streaks	4	362
Sand, white	3	365
Clay, white, soft	3	368
Clay, sandy, white, soft	2	370
Sand, white, free	4	374
Clay, white, soft	17	391
Clay, yellow, hard	8	399
Clay, pink, hard	2	401
Iron ore, hard	.5	401.5
Clay, pink and red, hard	3.5	405
Clay, drab, soft	24	429
Clay, dark drab, soft	6	435
Sand and gravel	25	460

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
6S3E-6		
Pleistocene deposits:		
(Not reported); shells	10	10
Sand	2	12
Clay, gray	8	20
Clay, dark	24	44
Clay, yellow	4	48
Sand and gravel	12	60
Patapsco formation:		
Clay, white	1	61
Sand and gravel	9	70
Clay, red	10	80
Clay, sandy, red and white	46	126
Arundel clay:		
Clay, red	69	195
Clay, gray	23	218
Clay, red	7	225
Patuxent formation:		
Sand, yellow	16	241
Sand	19	260
Clay, white	20	280
Clay, sandy, white	10	290
Sand, white	17	307
Clay, red	9	316
6S3E-7		
Pleistocene deposits and Patapsco formation:		
Sandy	13	13
Clay	1.5	14.5
Sandy	2	16.5
Clay	14.5	31
Clay, sandy	4	35
Clay, hard; gravel	40.5	75.5
Sand and clay	24	99.5
Arundel clay:		
Clay	38	137.5
Clay, sandy	28.5	166
Clay, red	3	169
Sand and gravel	4	173
Iron ore and clay in streaks	22	195
Clay, soft	5	200
Patuxent formation:		
Clay and sand streaks	51.3	251.3

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Iron ore	.5	251.8
Sand and clay with hard places	15.2	267
Sand	13	280
Sandy	8	288
Sandy, free	2	290
Clay	4	294
Sand, free	25	319
Clay	3	322
Sand, free	17	339
6S3E-8		
Pleistocene deposits and Patapsco formation:		
Sandy	10	10
Sand, yellow	10	20
Gravel; clay, gray	45	65
Gravel in clay	8	73
Sand, coarse; gravel, fine, with clay	22	95
Gravel, coarse	42	137
Arundel clay:		
Clay	30	167
Iron ore	33	200
Patuxent formation:		
Clay, sandy, red	5	205
Clay, sandy, brown	5	210
Clay, sandy, red and brown	25	235
Clay, red	5	240
Clay, sandy, gray	10	250
Clay, blue	5	255
Clay, sandy, gray, red, yellow	5	260
Sand, pink	5	265
Sand, yellow, fine	5	270
Sand, brown	5	275
Clay, sandy, brown	5	280
Sand and clay, brown	5	285
Sand and clay, yellow and brown	5	290
Sand, yellow	10	300
Sand, yellow and brown	5	305
Sand, brown	5	310
7S3E-3		
Pleistocene deposits and Patapsco formation:		
Surface	15	15
Sand, gravel, iron ore, and sandstone	24	39

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Clay, red and white	33	72
Clay, sandy, white	64.3	136.3
Clay, white	13.7	150
Sand, red; clay, white	25	175
Sand, white, very hard	12	187
Clay, white, with streaks of sand	36	223
Sand and gravel	21	244
7S5E-5		
Pleistocene deposits and Patapsco formation:		
Clay, pink	60	60
Clay, sandy, pink	40	100
Sand, buff, fine	20	120
Clay, white and buff, mottled	16	136
Sand; between clay beds (water)	1	137
1S1W-4		
Patuxent formation:		
Clay	45	45
Gravel	10	55
Clay	10	65
Pre-Cambrian rocks:		
Granite	35	100
1S1W-28		
Patuxent formation:		
Sand, yellow	10	10
Gravel and sand mixed	38	48
Clay, yellow	20	68
Pre-Cambrian rocks:		
Rock	17	85
1S1W-29		
Patuxent formation:		
Clay, white	20	20
Sand and gravel	27	47
Clay, yellow	18	65
Iron ore	8	73
Pre-Cambrian rocks:		
Clay, yellow; rock at 77 feet	4	77
1S1W-31		
Pleistocene deposits and Patuxent formation:		
Topsoil	22	22

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Sand, blue	2	24
Clay, sandy, yellow	7	31
Sand, yellow, clean (water); rock at 88 feet.	57	88
Pre-Cambrian rocks:		
(Not reported)	6	94
1S1W-34		
Patuxent formation:		
Sand	2	2
Clay, yellow; hard blue rock at 35 feet	33	35
Pre-Cambrian rocks:		
(Not reported)	70	105
1S2W-3		
Patuxent (?) formation:		
Rock, rotten	60	60
Pre-Cambrian rocks:		
Granite, hard	540	600
Granite, softer	150	750
Continued soft	267	1017
2S1W-24		
Recent deposits:		
Fill	6	6
Pleistocene deposits:		
Clay, blue	29	35
Sand, black	2	37
Gravel (water)	3	40
2S3W-1		
Pre-Cambrian rocks:		
Soil, soft	30	30
Rock, hard	150	180
Rock, very hard	16	196
2S4W-3		
Patuxent formation:		
Sand and clay, yellow	16	16
Pre-Cambrian rocks:		
Gneiss	238	254
2S4W-5		
Pre-Cambrian rocks:		
Earth, clay, and broken stone	17	17

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Rock, gray, hard	121	138
Mica rock	7	145
Rock, gray, hard	255	400
3S1W-5		
Pleistocene deposits:		
Earth	3	3
Gravel	15	18
Patuxent formation:		
Sand, white	6	24
Clay, brown	2	26
Clay, red; iron	24	50
Sand, fine	10	60
3S3W-1		
Recent deposits:		
Loam, fill	6	6
Patuxent formation:		
Clay, red	10	16
Clay, black	42	58
Sand	2	60
Gravel, white (water at 63 feet)	6	66
(Not reported)	2	68
Gravel, yellow	2	70
Pre-Cambrian rocks:		
Shale or mica clay	47	117
Granite, gray	3	120
Shale	9	129
Stone, blue (water encountered from 145 to 149 feet)	20	149
2N1E-2		
Recent and Pleistocene deposits and pre-Cambrian (?) rocks:		
Fill and clay	44	44
Pre-Cambrian rocks:		
Granite, very hard	26	70
Granite, black	30	100
Granite, gray	8	108
Granite, blue and very hard	92	200
Rock, gray; mica	35	235
Rock, gray; mica and pyrite	5	240
Micaceous rock, gray	120	360

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Granite, dark gray	25	385
Micaceous rock, light gray, soft	50	435
Flint rock, white	40	475
Rock, gray, hard	10	485
Limestone, white	285	770
Rock, black, very hard	20	790
2N1E-3		
Pleistocene deposits and pre-Cambrian rocks:		
Soil and clay	55	55
Pre-Cambrian rocks:		
Granite rock, very hard	47	102
Granite, blue, very hard	85	187
Micaceous rock, gray	153	340
Granite, gray, very hard	20	360
Rock, light gray; mica and pyrites	60	420
Flint, white	40	460
Granite, gray	50	510
Limestone, white	354	864
2N3E-2		
Pre-Cambrian rocks:		
Clay, yellow; rock at 55 feet	55	55
Rock	1245	1300
3N1E-1		
Pre-Cambrian rocks:		
Clay, brown	10	10
Clay, yellow	4	14
Serpentine	14.5	28.5
Hornblendite	35.5	64
Gneiss	121	185
3N1E-2		
Patuxent (?) formation:		
Earth and clay	31	31
Pre-Cambrian rocks:		
Hornblendite	28	59
Gabbro	10	69
Hornblendite	56	125
Gneiss	24.5	149.5
Gabbro	15	164.5
Hornblendite	16.5	181

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Gabbro	29	210
Hornblendite	20.5	230.5
3N1E-3		
Patuxent (?) formation:		
Topsoil and gravel	2	2
Sand and gravel, coarse	14.5	16.5
Pre-Cambrian rocks:		
Rock, soft	8	24.5
Hornblendite	99.5	124
Hornblende gneiss	60.5	184.5
3N1E-4		
Pre-Cambrian rocks:		
Clay and mica	5	5
Clay, sand, and mica	23.5	28.5
Gneiss	33	61.5
Gabbro	41.5	103
Pegmatite	9	112
Gabbro	26	138
Hornblendite	47	185
3N2E-1		
Patuxent (?) formation:		
Sand, brown and gray; clay	5	5
Sand, brown and gray; clay and gravel	8	13
Pre-Cambrian rocks:		
Rock, decomposed	2	15
Quartzite	120	135
3N3E-1		
Patuxent (?) formation:		
Clay, sandy, yellow	40	40
"Quicksand"	15	55
Sand and gravel, coarse	25	80
Pre-Cambrian rocks:		
Mica rock	123	203
3N3E-2		
Patuxent (?) formation:		
Clay, sandy, yellow	44	44
"Quicksand"	11	55
Sand and gravel, coarse	15	70

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Pre-Cambrian rocks:		
Rock, very hard	30	100
Rock, very soft	12	112
Rock, very hard		112
3N4E-1		
Pre-Cambrian rocks:		
Clay, red and yellow	65	65
Rock	94	159
4N3E-1		
Patuxent formation:		
Clay, red	20	20
"Quicksand"	15	35
Sand and gravel (water)	3	38
4N4E-2		
Patuxent formation:		
Surface	3	3
Clay, red	45	48
Red ochre	2	50
Gravel, cemented	10	60
Clay, blue "minebank," with iron ore	40	100
Sand; gravel, fine (water)	8	108
Pre-Cambrian rocks:		
Sand and clay, micaceous (no water) (rock at 112 feet)	4	112
1N1W-1		
Patuxent (?) formation:		
Sand, light	54	54
Clay, yellow	11	65
Pre-Cambrian rocks:		
Rock, gray, soft	15	80
Rock, harder (water)	10	90
Rock	225	315
1N1W-3		
Patuxent (?) formation:		
Sand	54	54
Clay	11	65
Pre-Cambrian rocks:		
Rock, soft	15	80
Rock, hard	35	115

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
2N3W-1		
Recent deposits:		
Fill	23	23
Pre-Cambrian rocks:		
Boulders	26.5	49.5
Rock, weathered and fractured	51	100.5
Pegmatite	8	108.5
Gabbro, iron-stained, fractured	24.5	133
Granite	136	269
2N3W-2		
Pleistocene (?) deposits:		
Sand, clay, and boulders	15	15
Pre-Cambrian rocks:		
Rock, disintegrated	20	35
Gabbro	235.5	270.5
2N4W-1		
Pre-Cambrian rocks:		
Clay	29	29
Serpentine, weathered	3	32
Serpentine	82	114
Metagabbro	10	124
Serpentine	16	140
Pyroxenite	42	182
Serpentine	9.5	191.5
Pyroxenite	41.5	233
Serpentine	80	313
3N1W-3		
Patuxent formation:		
Rock, soft	50	50
Pre-Cambrian rocks:		
Gneiss	125	175
Hornblende schist	125	300
3N1W-4		
Patuxent formation:		
Clay, sandy	45	45
Pre-Cambrian rocks:		
Gneiss clay	125	170
Hornblende schist	172	342

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
3N1W-5		
Pre-Cambrian rocks:		
"Rotten rock"	50	50
Hornblende schist	155	205
3N1W-6		
Pre-Cambrian rocks:		
Clay, brown; mica	10	10
Clay, brown and white; gravel; mica	9	19
Clay, white; mica	30	49
Rock, disintegrated	15.5	64.5
Gneiss	11.5	76
Pegmatite	10	86
Gneiss	61	147
Pegmatite	9	156
Gneiss	21	177
Pegmatite	9	186
Gneiss	21.5	207.5
3N1W-7		
Pleistocene deposits:		
Sand, brown; traces of clay and gravel	5	5
Sand, brown; traces of disintegrated rock	7	12
Pre-Cambrian rocks:		
Gneiss	19.5	31.5
Pegmatite	4.5	36
Gneiss	16	52
Pegmatite	4	56
Hornblendite	7	63
Pegmatite	10.5	73.5
Hornblendite	37	110.5
3N2W-6		
Pleistocene (?) deposits:		
Clay	7	7
Sand and clay	4	11
Pre-Cambrian rocks:		
Pegmatite	67	78
Hornblendite	13	91
3N2W-7		
Patuxent formation:		
(Not reported)	35	35

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Patuxent formation and pre-Cambrian rocks:		
Patuxent formation and weathered rock........	110	145
Pre-Cambrian rocks:		
Relay diorite..............................	65	210
(Not reported).............................	30	240
Gabbro.....................................	10	250
Gabbro (less weathered)....................	50	300
(Not reported).............................	5	305
Rock, hard, in stringers; quartz and feldspar	15	320
Gabbro (less weathered)....................	6	326
3N5W-1		
Recent deposits:		
Stone, crushed; concrete...................	0.5	0.5
Pleistocene deposits:		
Clay and sand..............................	8.5	9
Pre-Cambrian rocks:		
Serpentine, soft rock......................	20	29
Gabbro, fractured..........................	11	40
Metagabbro, fractured......................	68.5	108.5
Fresh gabbro, some fractures...............	75.5	184
Amphibolite................................	5.5	189.5
Metagabbro.................................	10	199.5
Metagabbro, leached........................	11.5	211
Metagabbro.................................	30	241
Metagabbro, fractured......................	17	258
Metagabbro.................................	15	273
Metagabbro, fractured......................	6	279
4N3W-1		
Pleistocene (?) deposits:		
Earth......................................	20	20
Pre-Cambrian rocks:		
Serpentine.................................	83	103
4N4W-1		
Pleistocene (?) deposits:		
Sand, clay, etc............................	40	40
Pre-Cambrian rocks:		
Gabbro, diorite, green.....................	150	190
AA-Ad 1		
Pleistocene deposits:		
Sand.......................................	15	15

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Patapsco formation:		
Clay, red	23	38
Conglomerate	2	40
Sand, medium	23	63
Gravel	2	65
Sand rock	6	71
Sand, fine	22	93
Sand rock	18	111
AA-Ad 2		
Pleistocene deposits:		
Topsoil and sand	6	6
Clay, sandy; gravel	4	10
Patapsco formation:		
Clay, red, hard	6	16
Sand, white, fine	2	18
Clay, white, soft	12	30
Clay, sandy, white, hard	17	47
Sand, brown	18	65
Sand and gravel (water)	30	95
Clay, white	12	107
Sand, silty, white	12	119
AA-Ad 8		
Patapsco formation:		
Loam, sandy	35	35
Sand	6	41
Sand and gravel	39	80
Clay, white	50	130
Clay, red	24	154
Arundel clay:		
Clay, brown, dark and drab, very stiff and tough	46	200
Patuxent formation:		
Clay and sand, brown	75	275
Clay, sand, and gravel, brown	20	295
Sand and gravel	6	301
Sand	4	305
Clay, brown	25	330
Clay, red	2	332
Clay, brown	18	350
Clay, sand, and gravel, white	27	377
Sandstone, brown	8	385
Sand and gravel	5.5	390.5

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
AA-Ad 9		
Patapsco formation:		
Loam, sandy	34	34
Clay and gravel	14	48
Clay, white	15	63
Clay, red	14	77
Clay, blue	13	90
Sand and clay	59.5	149.5
AA-Ad 10		
Patapsco formation:		
Loam, sandy	20	20
Sand	9	29
Sand and gravel	9	38
Clay, white	9	47
Sand	55	102
Gravel, iron-cemented	6.5	108.5
AA-Ad 11		
Patapsco formation:		
Loam, sandy	20	20
Sand, coarse, sharp	10	30
Gravel	4	34
Clay, white	13	47
Sand and clay	48	95
Sand, fine (water)	11	106
Clay, sand, and gravel, white	22	128
Sand	23	151
Arundel clay:		
Clay, red	9	160
Arundel and Patuxent formations:		
Clay, brown	83	243
Patuxent formation:		
Sand	12	255
Clay, red	7	262
(Not reported)	38	300
AA-Ad 14		
Water	9	9
Recent deposits:		
River mud, soft	8	17
Patapsco formation:		
Clay	5	22
Sand, fine, trace of clay	13.5	35.5

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
AA-Ad 15		
Water	24	24
Recent deposits:		
"River muck," soft	8	32
Patapsco formation:		
Sand, medium to hard	9	41
AA-Ad 16		
Patapsco formation:		
Loam, sandy	12	12
Sand and clay	58	70
Clay, red	5	75
Sand, coarse, sharp (water)	10	85
Sand; clay, red	43	128
Arundel clay:		
Clay, red	42	170
(Not reported)	12	182
AA-Ad 20		
Cretaceous sediments:		
Soil	4	4
Sand and gravel	68	72
Mud and sand	13	85
Clay, sandy, white	40	125
Sand, fine; mud	8	133
Clay, red and white	12	145
Sand, very fine	15	160
Sand, muddy	90	250
Clay, red	10	260
Clay, red and blue, tough	72	332
Clay, white	8	340
Clay, sandy, green	24	364
Sand, fine (water)	16	380
Sand, medium (water)	12	392
AA-Ae 4		
Pleistocene deposits:		
Clay, sandy	28	28
Patapsco formation:		
Clay, white, hard	34.7	62.7
Clay, sandy; brown streaks	20	82.7
Sand, white; drilled hard	5.3	88
Clay, hard	1.5	89.5

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Sand, hard	2.5	92
Clay, very hard	5	97
Sand, fine	16	113
Hard and soft streaks	10	123
Sand and gravel, good	11	134
Clay, white, hard	6	140
Sand, brown, free	3.6	143.6
Sand, brown, hard	2.4	146
Clay, white, hard	1	147
Sand, hard	5	152
Clay, sandy	2	154
Clay, white, hard	7	161
Clay, sandy	3.8	164.8
Clay, sandy; hard place	3.1	167.9
Clay, sandy	1.4	169.3
Clay, hard	9.5	178.8
Sand	.2	179
Clay, hard	.5	179.5
Sand, brown, free	2.8	182.3
Clay, red, very hard	1.7	184
Sand and gravel (water)	9	193
Arundel (?) clay:		
Clay	2	195

AA-Ae 5		
Pleistocene deposits:		
Clay, yellow, soft	5	5
Sand, yellow, soft	7	12
Clay, blue, soft	4	16
Sand, yellow, soft	3	19
Mud, black, soft	7	26
Patapsco formation:		
Sand, white, soft	9	35
Clay, red, white, hard	25	60
Clay, red, hard	18	78
Clay, sandy, white, soft	10	88
Sand, white, free	34	122
Sand, brown, free	3	125
Sand, white, free	10	135
Clay, sandy, white, soft	5	140
Sandstone, white, hard	4	144
Clay, sandy, white, soft and hard	26	170
Rock, very hard	2	172

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Clay, sandy, white, soft	5	177
Rock, very hard	4	181
Clay, white, hard	2	183
Sand and gravel, free	6	189
AA-Ae 11		
Pleistocene deposits and Patapsco formation:		
Clay, blue	40	40
Loam, sandy	29	69
Sand and gravel	6	75
AA-Ae 12		
Water	21	21
Recent deposits:		
"River muck," soft	6	27
Patapsco formation:		
Sand, fine; clay and gravel	3	30
Sand and clay, medium hardness	6	36
Clay, white, hard	2.5	38.5
AA-Ae 13		
Water	21.5	21.5
Recent deposits:		
"River muck," soft	6.5	28
Patapsco formation:		
Sand, fine	2	30
Sand, fine, medium hardness	5	35
Clay, white, hard	4	39
AA-Ae 14		
Water	22	22
Recent deposits:		
"River muck," soft	15	37
Patapsco formation:		
Sand, fine	6	43
Clay, moderately stiff	9	52
AA-Ae 15		
Water	21.5	21.5
Recent deposits:		
"River muck," soft	9.5	31
Patapsco formation:		
Sand, fine, medium hardness	20.5	51.5

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
AA-Ae 16		
Water	20	20
Recent deposits:		
"River muck," soft	7	27
Patapsco formation:		
Sand, fine; clay	3	30
Sand; clay, white	2	32
Sand, fine	8	40
AA-Ae 18		
Pleistocene (?) deposits and Patapsco formation:		
Clay	5	5
Sand	6	11
Clay	4	15
Sand	5	20
Clay	8	28
Sand	7	35
Clay	53	88
Sand	47	135
Clay, sandy	5	140
Sand	3	143
Clay, sandy	35	178
Clay	4	182
Gravel	8	190
AA-Ae 19		
Pleistocene deposits:		
Clay, sandy	28	28
Patapsco formation:		
Clay	34	62
Clay, sandy	10	72
Sand	12	84
Clay	4	88
Sand	24	112
Clay, sandy, hard and soft	12	124
Sand and gravel	11	135
Clay, sandy	5	140
Sand	2	142
Clay, sandy	36	178
Sand	5	183
Sand and gravel	11	194

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
AA-Ae 20		
Pleistocene and Cretaceous sediments:		
Clay, sandy	60	60
Clay	65	125
Clay, sandy; clay at bottom	40	165
Clay	11	176
Sand	12	188
Clay	7	195
Sand	30	225
Clay, sandy	20	245
Sand and gravel	22	267
Clay, sandy	13	280
Sand	22	302
Clay, sandy	53	355
Sand	9	364
Clay	5	369
Sand, gravel, and boulders	21	390
Clay	10	400
AA-Bb 5		
Pleistocene (?) deposits:		
Soil	3	3
Sand and gravel	27	30
Patuxent formation:		
Clay, blue; clay, white, in streaks	20	50
Clay, white	14	64
Clay, sandy, white (some water)	24	88
Clay, white	2	90
Clay, red	42	132
Clay, light blue	10	142
Clay, blue, stiff	6	148
Sand, fine	4	152
Clay, blue and pink	5	157
Sand, medium fine (water)	21	178
Clay, blue	12	190
Pre-Cambrian rocks:		
Rock	9	199
AA-Bd 1		
Patapsco formation:		
Clay	42	42
Sand, fine	23	65

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
AA-Be 4		
Patapsco formation:		
Sand	17	17
Clay, red	73	90
Sand	2	92
Clay	25	117
Sand	8	125
AA-Be 6		
Raritan and Patapsco formations:		
(Not reported)	60	60
Clay, red	35	95
Sand, white (little water)	5	100
Clay, blue	25	125
Sand, iron-crusted	1	126
Clay, white	3	129
Sand	2	131
Clay, sandy	14	145
AA-Be 7		
Raritan and Patapsco (?) formations:		
Loam	3	3
Clay, yellow	5	8
Sand, fine	8	16
Sand, white	9	25
Sand, coarse	11	36
Sand, fine	10	46
Clay, red	2	48
Sand, fine	6	54
Clay, white	3	57
Sand, fine	10	67
Clay, yellow	3	70
Sand, fine	10	80
Clay, yellow	1	81
Sand, fine	11	92
Sand, coarse	7	99
AA-Bf-2		
Raritan and Patapsco formations:		
Sand, yellow, fine	40	40
Clay, red and brown	235	275
Sand, coarse	80	355
Sand, fine	5	360

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Bal-Ea 1		
Pre-Cambrian rocks:		
Clay; rock, soft	10	10
Rock, fresh, iron-stained	8	18
Quartz layers	16	34
Mica schist	9	43
Quartz layers	5	48
Mica schist	35	83
Quartz layer	5	88
Mica schist	12	100
Quartz layer	7	107
Mica schist	10	117
Quartz layer	16	133
Quartz lenses	10	143
Mica, small	10	153
Quartz vein	10	163
Quartz layers	10	173
Mica schist	4	177
Quartz	10	187
Quartzose	9	196
Mica schist, crinkled bedding	6	202
Bal-Ea 2		
Pre-Cambrian rocks:		
Earth	45	45
Schist, quartzose, massive, iron-stained	26	71
Schist with garnets, iron-stained, fractured.	10	81
Schist, iron-stained	45	126
Schist; quartz layers	10	136
Schist	10	146
Schist, fractured, much iron stain, tourmaline	10	156
Schist, iron-stained, fractured	8	164
Schist	26	190
Quartz	2	192
Schist, fractured	14	206
Schist	18	224
Quartz layers	3	227
Schist	43	270
Bal-Ea 3		
Pre-Cambrian rocks:		
Clay and sand	7	7
Mica schist	1	8

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Mica schist, iron-stained	5	13
Mica schist	1	14
Quartz	7	21
Quartz layers	4	25
Mica schist, iron-stained	5	30
Mica schist; quartz layers	10	40
Mica schist, coarse	33	73
Mica schist, coarse, crinkled	41	114
Bal-Ea 4		
Pre-Cambrian rocks:		
Earth	28	28
Schist, weathered	1	29
Schist, iron-stained, friable	7	36
Granite, pegmatite	1	37
Schist, quartzose, coarse	111	148
Bal-Ea 5		
Pre-Cambrian rocks:		
Earth	5	5
Schist, weathered	3	8
Schist, iron-stained	26	34
Schist, quartzose	158	192
Bal-Eb 1		
Pre-Cambrian rocks:		
(Not reported)	32	32
Rock, disintegrated (water)	1	33
(Not reported)	9	42
Rock, disintegrated (water)	1	43
(Not reported)	7	50
Rock, disintegrated, less permeable	1	51
(Not reported)	11	62
Schist, weathered	1	63
(Not reported)	9	72
Schist, slightly weathered, iron-stained	1	73
(Not reported)	2	75
Schist, very slightly weathered	1	76
(Not reported)	1	77
Schist, slightly weathered	2	79
Schist, with quartz veins	1	80
(Not reported)	3	83
Schist, iron-stained	5	88

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
(Not reported)	2	90
Schist; many quartz veins	6	96
(Not reported)	1	97
Schist, fine texture	14	111
(Not reported)	1	112
Schist; quartz veins	13	125
(Not reported)	1	126
Quartzite, dense	3	129
(Not reported)	1	130
Quartzite	15	145
Schist	12	157
(Not reported)	1	158
Schist, dense	67	225
Bal-Eb 2		
Pre-Cambrian rocks:		
Earth	76	76
Granite, pegmatite	21	97
Mica schist, plane-bedded	5	102
Mica schist, coarsely crinkled	4	106
Mica schist, coarse	12	118
Quartz layer	9	127
Mica schist, coarse	49	176
Quartz	2	178
Mica schist	19	197
Mica schist, crinkled	18	215
Mica schist	33	248
Mica schist, crinkled	6	254
Granite, pegmatite	4	258
Mica schist, fine, massive	10	268
Mica schist (pegmatite granite - 6 inches)	37	305
Mica schist, medium coarse, even-bedded	14	319
Mica schist	23	342
Bal-Eb 3		
Pre-Cambrian rocks:		
Sand	11	11
Gabbro, iron-stained	4	15
Gabbro, coarse, mottled	16	31
Hornblende gneiss	13	44
Gabbro, coarse, mottled	166	210

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Bal-Eb 4		
Pre-Cambrian rocks:		
Sand and clay, red	22	22
Rock, disintegrated; clay	16	38
Rock, disintegrated	8	46
Mica schist	6	52
Quartz	4	56
Mica schist, coarse, iron-stained	6	62
Mica schist, fractured, iron-stained	4	66
Mica schist	5	71
Mica schist, crinkled	67	138
Mica schist (pegmatite granite - 4½ feet)	15	153
Mica schist	14	167
Mica schist, fractured, some cement	6	173
Mica schist (pegmatite granite - 6 inches)	6	179
Mica schist, medium-grained	5	184
Mica schist, crinkled	61	245
Mica schist	47	292
Mica schist, crinkled	17	309
Bal-Eb 5		
Pre-Cambrian rocks:		
Clay and sand	10	10
Sand, mica; traces of clay	24	34
Rock, decomposed	10	44
Mica schist, iron-stained, weathered	10	54
Mica schist, coarsely crinkled	5	59
Mica schist, crinkled	26	85
Mica schist, fractured, some cemented	10	95
Mica schist	51	146
Mica schist (pegmatite granite - 6 inches)	8	154
Mica schist	131	285
Bal-Eb 6		
Pre-Cambrian rocks:		
Sand, clay, and small stones	10	10
Mica schist	4	14
Mica schist, iron-stained, fractured	4	18
Mica schist, iron-stained	9	27
Mica schist	3	30
Granite, pegmatite	3	33
Mica schist	6	39
Quartz layer	10	49

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Mica schist	40	89
Granite, pegmatite	19	108
Mica schist	7	115
Granite, pegmatite	6	121
Mica schist	24	145
Granite, pegmatite, intercalated	10	155
Mica schist (pegmatite granite - 3 feet)	10	165
Mica schist, fractured	14	179
Mica schist	11	190
Mica schist (pegmatite granite - 1 foot)	10	200
Rock, soft	25	225
Mica schist	25	250
Bal-Eb 7		
Pre-Cambrian rocks:		
Clay, red; gravel	10	10
Clay, yellow	22	32
Clay, red and yellow	24	56
Hornblende gneiss, contains garnet	8	64
Hornblende gneiss	10	74
Hornblende gneiss, fractured	6	80
Gabbro, mottled	31	111
Quartz (gabbro sand)	6	117
Gabbro, mottled	8	125
Pyroxenite, tan	7	132
Amphibolite, fractured	58	190
Gabbro, mottled	5	195
Amphibolite, fractured, some cemented	22	217
Gabbro, mottled	14	231
Garnet gabbro, steep fractures	14	245
Mica schist, contains garnet	35	280
Bal-Ec 1		
Pre-Cambrian rocks:		
Earth	11	11
Rock, fine-grained	96	107
Hornblende gneiss	5	112
Rock, coarse, fractured	9	121
Rock, coarse	8	129
Rock, coarse, mottled	10	139
Rock, coarse, mottled, some fractures	13	152
Rock, medium-grained, some fractures	13	165
Rock, medium-grained, fractured, some cemented	20	185

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Bal-Ec 2		
Pre-Cambrian rocks:		
Clay, red	1	1
Clay, green and red	6	7
Boulders, broken; gravel and clay	18	25
Clay and sand, brown	13	38
Sand; traces of clay	35	73
Gabbro, weathered; soft broken rock	26	99
Gabbro, weathered, cemented and open fractures	6	105
Peridotite carbonate, cemented fractures	7	112
Peridotite carbonate, cemented, highly fractured	111	223
Bal-Ef 10		
Cretaceous sediments:		
Sand	10	10
Clay, red	70	80
Sand	55	135
Bal-Ef 11		
Patuxent formation:		
Clay	20	20
Sand	8	28
Gravel	22	50
Clay, yellow; clay, red; clay, white; some sand	62	112
Pre-Cambrian rocks:		
Rock	87	199
Bal-Ef 20		
Patuxent formation:		
Soil	8	8
Sand, clayey, brown	27	35
Gravel	1	36
Sand mixed with small amount of clay	34	70
Clay, red; clay, white	61	131
Pre-Cambrian rocks:		
Schist; rock, soft, at 450 feet	360	491
Granite (water at contact)	1	492
Bal-Ef 22		
Cretaceous sediments:		
Clay, light red	10	10

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Sand, fine	10	20
Clay, red	15	35
Sandstone	1	36
Clay, red	3	39
Sandstone	1	40
Clay, red	6	46
Sandstone	1	47
Clay, red	3	50
Sandstone	1	51
Clay, red	12	63
Sandstone	1	64
Clay, red	22	86
Sandstone	1	87
Clay, red	3	90
Sandstone, very hard	1	91
Clay, yellow	4	95
Sandstone, very hard	1	96
Clay, red	6	102
Cavity	1	103
Sand, coarse	2	105
Bal-Ef 23		
Cretaceous sediments:		
Sand	6	6
Clay, yellow	2	8
Sand	4	12
Clay, yellow	3	15
Sand	22	37
Clay, red	1	38
Clay, yellow	16	54
Sand, fine	5	59
Bal-Eg 5		
Cretaceous sediments:		
Clay	151	151
Sand	7	158
Bal-Fe 2		
Pleistocene (?) deposits and Patapsco formation:		
Sand	15	15
Clay	25	40
Sand	5	45

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Arundel clay:		
Clay	75	120
Patuxent formation:		
Sand	15	135
Clay	9	144
Sand	13	157
Clay	1	158
Sand	4	162
Clay	7	169
Sand	6	175
Bal-Fe 14		
Pleistocene (?) deposits and Patapsco formation:		
(Not reported)	25	25
Clay, hard	12	37
Sand	1	38
Clay, sandy, yellow	7	45
Sand	14	59
Arundel clay:		
Clay, red and yellow	35	94
Iron ore	.5	94.5
Sandy	2.5	97
Sand, fine, hard	7	104
Clay	22	126
Patuxent formation:		
Sand, fine, hard; wood	11	137
Sandy	3	140
Sand, white	7	147
Sand	14.7	161.7
Clay	.3	162
Sand and gravel	20	182
Pre-Cambrian rocks:		
Bedrock		182
Bal-Fe 16		
Patapsco formation:		
Sand and clay	20	20
Sand streaks; clay and gravel	33	53
Clay, hard	15.7	68.7
Sand	1	69.7
Clay	3.3	73
Sandy	59	132

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Arundel clay:		
Clay, hard	37	169
Clay, sandy	21	190
Clay, hard	23	213
Patuxent formation:		
Sand, free in places	10.8	223.8
Clay, hard	5.2	229
Sand	2	231
Clay	.5	231.5
Sand, fine, free in places	10.3	241.8
Clay streaks; sand	7.2	249
Clay	3	252
Clay, sandy	4	256
Sand, fine, free	8	264
Clay	.7	264.7
Sand, fine, free	4.1	268.8
Clay	.5	269.3
Sand, free	2	271.3
Clay	.2	271.5
Sand	2.5	274
Clay	1.4	275.4
Iron ore	.4	275.8
Clay	.9	276.7
Hard	.2	276.9
Clay	30.4	307.3
Clay, harder	7.9	315.2
Boulder or iron ore	.4	315.6
Softer	.4	316
Hard	.8	316.8
Clay	3.6	320.4
Boulder	1	321.4
Clay	10.6	332
Sand and gravel	4	336
Clay	3.8	339.8
Boulder	.4	340.2
Soft	.8	341
Boulder	.3	341.3
Clay	2.7	344
Sandy	3	347
(Not reported)	1	348
Gravel	6.5	354.5
Sand; some gravel	2	356.5
Clay	4.5	361

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Sand	3.5	364.5
Clay	3.4	367.9
Sand; some gravel, fine	5.1	373
Sand; gravel, coarse	3.3	376.3
Clay, hard	2.7	379
Bal-Fe 24		
Pleistocene deposits and Patapsco formation:		
Sand; iron crusts	110	110
Clay, red, tough	35	145
Clay, sandy, white	10	155
Sand, white, coarse	17.5	172.5
Bal-Fe 35		
Cretaceous sediments:		
Sand	40	40
Clay, red	100	140
Bal-Ff 2		
Pleistocene deposits:		
Gray	12	12
Sand, fine and coarse mixed	2	14
Bal-Ff 7		
Pleistocene (?) deposits:		
Sand	30	30
Patapsco formation:		
Clay, red	40	70
Sand	8	78
Bal-Ff 8		
Pleistocene deposits:		
Sand	8	8
Patapsco formation:		
Sand rock	2	10
Sand, coarse	20	30
Clay, red and yellow	20	50
Sand, yellow, fine	50	100
"Charcoal"	6	106
Clay, yellow	6	112
Bal-Ff 9		
Pleistocene deposits:		
Clay, light	20	20

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Clay, gray	28	48
Patapsco formation:		
Clay, red	38	86
Sand	4	90
Bal-Ff 10		
Pleistocene deposits:		
Sand	10	10
Patapsco formation:		
Clay, white	20	30
Sand	12	42
Clay, white	1	43
Sand	5	48
Clay, white	2	50
Sand	22	72
Bal-Ff 11		
Pleistocene deposits:		
Sand, "loamy"	15	15
Patapsco formation:		
Clay, red	45	60
Sand	8	68
Bal-Ff 13		
Cretaceous sediments:		
Sand, white	30	30
Clay, blue and black	20	50
Hardpan, white	80	130
Boulder	3	133
Sand, pink (water)		133
Bal-Ff 15		
Cretaceous sediments:		
Clay, different-colored	168	168
Sand, fine	1	169
Clay, white	47	216
Sand		216
Bal-Ff 16		
Pleistocene deposits:		
Sand, coarse	10	10
Patapsco formation:		
Clay, light red	10	20

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Clay, red	14	34
Sand, fine	30	64
Clay, light red	16	80
Clay, gray, hard	20	100
Clay, "loamy"	30	130
Sand	10	140
Bal-Ff 17		
Pleistocene deposits:		
Sand	10	10
Cretaceous sediments:		
Clay, light red	15	25
Clay, red	15	40
Clay, white	2	42
Sand, fine	16	58
Clay, pink	2	60
Sand, fine	20	80
Clay, yellow	2	82
Sand, fine	12	94
Clay, pink	1	95
Sand, fine	10	105
Clay, light red	3	108
Sand, fine	11	119
Clay, light	1	120
Sand, fine	9	129
Cavity	1.5	130.5
Clay, pink	3	133.5
Sand, fine	10	143.5
Clay, yellow	2	145.5
Sand, fine	8	153.5
Clay, light red	3	156.5
Sand, fine	14	170.5
Clay, white	2	172.5
Sand, fine	8	180.5
Clay, white	3	183.5
Sand, fine	7	190.5
Sand, white	4	194.5
Sand, fine	5	199.5
Gravel	1	200.5
Bal-Ff 18		
Pleistocene deposits:		
Sand, coarse	10	10

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Cretaceous sediments:		
Clay, gray	6	16
Sandstone	1	17
Clay, gray, mixed with "charcoal"	4	21
Clay, gray	12	33
Clay, red	2	35
Clay, white	5	40
Sand, fine	1	41
Clay, brown	4	45
Clay, orange	5	50
Sand, fine	20	70
Clay, light red	7	77
Sand, fine	13	90
Clay, light red	5	95
Sand, fine	10	105
Clay, red	2	107
Sand, fine	44	151
Sandstone	1	152
Clay, red	2	154
Clay, light red	10	164
Gravel	1	165
Sand, fine	5	170
Clay, light	1	171
Sand, coarse	5	176
Bal-Ff 19		
Pleistocene deposits:		
Mud, black	5	5
Sand, fine	20	25
Patapsco formation:		
Clay, red	6	31
Sand, fine	8	39
Sandstone, coarse	1	40
Bal-Ff 20		
Patapsco formation:		
Clay, red	15	15
Sand, coarse	7	22
Clay, red	36	58
Sandstone	3	61
Sand, fine	3	64
Clay, red	6	70
Sand, coarse	4	74

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Clay, red	6	80
Sand, fine	4	84
Clay, red	10	94
Sand, fine	6	100
Sandstone, very hard	1	101
Arundel clay:		
Clay, red	119	220
Patuxent formation:		
Sandstone	1	221
Sand, coarse	3	224
Bal-Ff 21		
Pleistocene (?) deposits:		
Clay, gray	86	86
Sand and gravel, coarse	4	90
Bal-Ff 22		
Pleistocene deposits:		
Sand, coarse	10	10
Clay, yellow	5	15
Patapsco formation:		
Clay, red	10	25
Clay, gray	25	50
Clay, white	5	55
Sand, fine	10	65
Sand, coarse	2	67
Bal-Ff 23		
Pleistocene deposits:		
Sand, coarse	8	8
Clay, yellow	7	15
Patapsco formation:		
Clay, red	10	25
Clay, gray	30	55
Clay, white	5	60
Sand, fine	10	70
Sand, coarse	3	73
Bal-Ff 24		
Pleistocene (?) deposits:		
(Not reported)	39	39
Patapsco formation:		
Sand, free in places	20	59

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Clay and sand, hard	11	70
Clay, hard	74	144
Sand, free in places	19	163
Clay	5	168
Sandy with clay streaks	11	179
Clay, sandy	7	186
Arundel and Patuxent formations:		
Clay, blue, hard	17	203
Sand	3.3	206.3
Clay	.3	206.6
Sand	3.4	210
Clay	2	212
Sand	10	222
Clay	3.3	225.3
Sand	7.3	232.6
Bal-Ff 25		
Pleistocene deposits:		
Sand	15	15
Patapsco formation:		
Clay, red	85	100
Sand	10	110
Bal-Ff 28		
Pleistocene deposits and Patapsco formation:		
Sand	19	19
Clay	11	30
Gravel	61	91
Bal-Ff 33		
Pleistocene deposits:		
Loam	6	6
Sand, coarse	2	8
Patapsco formation:		
Clay, light red	10	18
Clay, red	12	30
Clay, light red	12	42
Clay, red	8	50
Clay, light red	12	62
Clay, red	20	82
Loam	14	96
Sand, coarse	4	100

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Bal-Ff 34		
Pleistocene deposits:		
Clay	20	20
Sand	2	22
Patapsco formation:		
Clay	83	105
Clay, sandy	20	125
Sand	30	155
Clay, white	20	175
Clay, sandy	10	185
Arundel clay:		
Clay	90	275
Patuxent formation:.		
Clay, sandy	25	300
Clay	25	325
Sand and gravel	16.5	341.5
(Not reported)	23.5	365
Bal-Fg 2		
Pleistocene deposits:		
Loam	10	10
Cretaceous sediments:		
Clay, red	50	60
Clay, gray	4	64
Clay, light red	36	100
Sand, coarse	8	108
Bal-Fg 3		
Patapsco formation:		
Clay, white	10	10
Sand, coarse	35	45
Clay, red	55	100
Sand	10	110
Bal-Fg 7		
Pleistocene deposits:		
Clay, red	8	8
Sand, coarse	4	12
Clay, gray	20	32
Patapsco formation:		
Clay, light red	60	92
Clay, red	42	134
Rock sandstone	4	138

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Sand, fine	10	148
Sand, coarse	2	150
Bal-Fg 8		
Pleistocene deposits and Patapsco formation:		
Clay, mottled red and white	150	150
Sand	2	152
Clay, white and yellow	80	232
Clay, yellow	15	247
(Not reported)	13	260
Bal-Fg 9		
Pleistocene deposits:		
Clay, red	7	7
Sand, coarse	3	10
Clay, gray	30	40
Patapsco formation:		
Clay, red	95	135
Sandstone, first foot very hard	5	140
Clay, red	5	145
Sand, white, fine	12	157
Sand, white, coarse	3	160
Bal-Fg 11		
Pleistocene deposits:		
"Swamp mud"	4	4
"Quicksand"	20	24
Clay, gray	4	28
Patapsco formation:		
Clay, light-red	6	34
Clay, red	5	39
Sand, fine	11	50
Sand, coarse	3	53
Bal-Fg 12		
Pleistocene deposits:		
Topsoil	1	1
Clay, yellow	15	16
Sand, fine	6	22
Clay, gray	71	93
Sand, fine	2	95
Clay, gray	1	96
Sand, fine	3	99

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Clay, white	1	100
Sand, fine	4	104
Clay, gray, mixed with "charcoal"	2	106
Sand, fine	9	115
Wood and small nuts	1	116
Clay, gray	2	118
Sand, fine	20	138
Patapsco formation:		
Clay, red	1	139
Clay, light red	6	145
Clay, pink	8	153
Clay, light red	1	154
Clay, pink	5	159
Clay, light red	1	160
Clay, orange-colored	5	165
Clay, light-pink	21	186
Sand, fine	21	207
Sand, coarse	4	211
Clay, gray; "charcoal"	1	212
Clay, gray	19	231
Clay, red; stone 1 inch thick	1	232
Sand, fine; stone 1 inch thick	4	236
Loam, red	20	256
Sand, fine; hard sandstone 6 inches thick	2	258
Sand, fine; sandstone 1 inch thick	6	264
Clay, light red	2	266
Sand, fine	10	276
Sand, coarse	5	281
Bal-Fg 13		
Patapsco formation:		
Loam	4	4
Clay, white	6	10
Clay, light red	6	16
Sand, fine	1	17
Clay, white	6	23
Sand, fine	1	24
Clay, red	7	31
Clay, orange-colored	16	47
Clay, dark orange-colored	18	65
Loam; clay, red	3	68
Clay, orange-colored	1	69
Sand, fine	2	71

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Clay, orange-colored	1	72
Sand, fine	1	73
Clay, yellow	30	103
Clay, dark yellow	7	110
Rock, hard	1	111
Sand, coarse	6	117

Bal-Fg 15		
Pleistocene deposits:		
Clay, yellow	14	14
Sand, fine	7	21
Clay, gray and green	65	86
Sand and gravel, fine	10	96
Clay, gray; mixed with decayed wood	2	98
Sand, coarse (water)	12	110
Patapsco formation:		
Clay, white	6	116
Sand, fine	10	126
Clay, light red	14	140
Sand, fine; "charcoal"	16	156
Clay, light red	2	158
Clay, gray; "charcoal"	12	170
Clay, red	6	176
Clay, brown	4	180
Sand, fine	6	186
Clay, gray	1	187
Sand, fine (water)	15	202
Clay, gray	8	210
Clay, light red	6	216
Sandstone	.2	216.2
Clay, gray	2.8	219
Rock, hard	.4	219.4
Clay, gray	.6	220
Sandstone	2	222
Clay, gray	3	225
Sandstone	1	226
Clay, gray	4	230
Clay, red	5	235
Clay, light red	3	238
Clay, yellow	6	244
Clay, gray	13	257
Sandstone	.3	257.3
Clay, red	1.7	259

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Sand, coarse	21	280
Rock, hard; clay, yellow, at 280.5 feet	.5	280.5
Bal-Gc 15		
Pleistocene deposits:		
Soil and clay, yellow	11	11
Clay, sandy, yellow	3	14
Sand, yellow	11	25
Patuxent formation:		
Gravel and clay, red	18	43
Sand, yellow (water)	7	50
Clay, blue	23	73
Clay, blue; gravel	6	79
Gravel	7	86
Gravel; clay, white	5	91
Sand and gravel (water)	12	103
Bal-Gc 16		
Pleistocene deposits:		
Clay and soil, yellow	14	14
Patuxent formation:		
Clay, red	14	28
Clay, red; gravel	17	45
Sand, yellow	4	49
Clay, red	4	53
Sand, yellow (water)	7	60
Clay, blue	26	86
Clay, blue; gravel	9	95
Sand and gravel, white (water)	12	107
Bal-Gc 17		
Pleistocene deposits:		
Soil, sandy, yellow	6	6
Patuxent formation:		
Clay, red	12	18
Clay, red; gravel	13	31
Clay, red	27	58
Clay, blue	26	84
Clay, blue; gravel	7	91
Gravel and sand, white	12	103
Bal-Gc 18		
Pleistocene deposits:		
Topsoil, yellow	9	9

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Patuxent formation:		
Clay, red	13	22
Clay, yellow	17	39
Clay and gravel, yellow	7	46
Sand, yellow	7	53
Clay, blue	28	81
Clay, blue and white; gravel	16	97
Gravel and sand, white	12	109
Pre-Cambrian rocks:		
Clay, greenish blue	10	119
Rock, "rotten"	6	125
Rock		125
Bal-Ge 6		
Pleistocene deposits and Patapsco formation:		
Clay, yellow	20	20
Boulders	64	84
Soil, sandy	36	120
(Not reported)	34	154
Sand, red, coarse (water)	3	157
Clay, red, tough	43	200
Sand, nearly white, coarse (water)	26	226
Bal-Ge 7		
Pleistocene deposits:		
Clay, blue	19	19
Sand and gravel (water)	2	21
Clay, blue	1	22
Patapsco formation:		
Clay, red	70	92
Sand, fine	13	105
Clay to sand, yellow	10	115
Sand, white, fine	16	131
Clay, white	11	142
Sand, white, indurated	3	145
Clay, white	4	149
Sand and clay, white	10	159
Clay, blue	3	162
Clay, red	33	195
Clay, white	4	199
Clay, sandy, red	2	201
Sand, red	2	203
Gravel and sand	31	234

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Arundel clay:		
Clay, blue	26	260
Clay, pink	11	271
Clay, blue	11	282
Sand, red, indurated	2	284
Patuxent formation:		
Sand, red (water)	3	287
Bal-Ge 8		
Pleistocene deposits:		
Sand fill, white	10	10
Sand, yellow; mixed with oyster shells	46	56
Clay, yellow	41	97
Patapsco formation:		
Sand and gravel, gray-white (little water)	26	123
Fire clay, white	27	150
Sand and gravel, white, coarse (water)	6	156
(Not reported)	12	168
Bal-Ge 9		
Recent deposits:		
Artificial fill	21	21
Pleistocene deposits:		
Sand and mud with oyster shells	9	30
Sand	8	38
Gravel and boulders of quartz	6	44
Clay, blue and yellow	3	47
Gravel and boulders of quartz	5	52
Clay, blue	2	54
Sand, brown, fine	3	57
Clay, blue, tough	6	63
Clay, variegated; with vegetable matter	12	75
Sand	2	77
Clay	3	80
Clay, sandy, red	4	84
Sand, gravel and boulders, with an overflow of chalybeate water	29	113
Patapsco formation:		
Clay, variegated, red, white, blue, and yellow	39	152
Sand and gravel with chalybeate water	21	173
Clay, sandy, white	9	182
Sand, white, fine	6	188
Clay, light-colored	20	208

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Sand	2	210
Clay, white, fine; sand, white; in layers	37	247

	Thickness (feet)	Depth (feet)
Bal-Gf 5		
Pleistocene deposits:		
(Not reported)	17	17
Sand	3	20
Clay, blue	11	31
Sand, hard; clay, in streaks	10	41
Gravel	32	73
Patapsco formation:		
Clay and sand	17	90
Sand, hard	30	120
Clay	14	134
Sand, free	20	154
Clay streaks	12	166
Sand, free	9	175
Clay	2	177
Sand, free	12.4	189.4
Clay, red, hard	15.6	205
Clay, sandy	19	224
Sand, free	17	241
Gravel	2	243
Arundel clay:		
Clay	27.8	270.8
Boulder	.2	271
Clay	1.8	272.8
Boulder	.2	273
Clay	8	281
Boulder	.3	281.3
Clay	1.8	283.1
Boulder	.9	284
Clay	6	290
Hard	2	292
Clay, hard	128.8	420.8
Boulder or iron ore	.4	421.2
Clay	3.5	424.7
Patuxent formation:		
Sand, yellow	2.3	427
Sand and gravel	13	440
Clay, hard	2	442
Sandy	5	447
Clay, red	1	448

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Clay, sandy	3	451
Sand, free	3	454
Clay, sandy	15	469
Sand	1	470
Clay	5	475
Sand, free	14	489
Clay, hard	10.3	499.3
Sand	9.5	508.8
Clay	2	510.8
Sand	1.6	512.4
Iron ore	1.6	514
Clay, red	27	541
Clay, blue; sand, in streaks	11	552
Sandy, hard; gravel, in streaks	22	574
Clay, sandy	4.8	578.8
Gravel	5.7	584.5
Red	14.3	598.8
(Not reported)	11.2	610

Bal-Gf 10		
Pleistocene deposits:		
Clay, brown	18	18
Clay, blue; sand streaks	34	52
Sand and gravel, free	21	73
Patapsco formation:		
Clay, white, tough	18	91
Clay, sandy	39	130
Clay, hard	10	140
Clay, softer	10	150
Sandy	24	174
Clay, hard	6	180
Sand and gravel, free	6	186
Clay, hard	1	187
Sandy	3	190
Clay, red, very hard	11	201
Clay, red	19	220
Sandy	2	222
Sand and gravel, free	1	223
Clay	13	236
Sandy	20	256
Sand and gravel, free	5	261
Arundel clay:		
Clay, very hard	57	318

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Sandy	2	320
Clay, red, hard	8	328
Sandy	3	331
Clay, red, hard	4	335
Sandy	11	346
Clay, red, hard	18	364
Clay, hard	2.5	366.5
Iron ore	.2	366.7
Sand	1	367.7
Iron ore	.3	368
Clay, hard	14	382
Clay, red, hard	2	384
Clay, red, extra hard	14	398
Clay, red, softer	20	418
Patuxent formation:		
Sandy; clay, white and brown	23	441
Sand, free	7	448
Sand, tight	5	453
Sand and gravel, loose	4	457
Sand and gravel, free	3	460
Clay, soft	2	462
Sandy	4	466
Sand, loose	18	484
Gravel, free	3	487
Clay, white	.5	487.5
Gravel, free	9.5	497
Clay, soft	5	502
Very sandy	3	505
Sand, free; some gravel	15	520
Gravel, very free	9	529
Clay, white	1	530
Sand and gravel, very free	25.4	555.4
Clay, very hard	24.6	580
Sand and gravel, free	.7	580.7
Clay	2	582.7
Wood; sand and gravel, very loose	6	588.7
Gravel, tight	2	590.7
Gravel, more loose	2	592.7
Sand and gravel, very free, large	18.3	611
Sand and gravel, free	9	620
Clay	1	621
Gravel	7	628
Gravel, free	3	631

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Gravel, tight	1	632
Clay	1	633
Clay, sandy, brown and white	19	652
Mica, gray; clay, green	4	656
Gravel	1	657
Gravel, tight	.8	657.8
Pre-Cambrian rocks:		
Rock	53.2	711

	Thickness (feet)	Depth (feet)
Bal-Gf 12		
Recent deposits:		
Slag	10	10
Pleistocene deposits:		
Clay, yellow	10	20
Clay, blue, soft	6	26
Sand and gravel	4	30
Clay, dark, soft	17	47
Gravel	7	54
Clay, dark, soft	16	70
Gravel, large	10	80
Patapsco formation:		
Clay	48	128
Sand and gravel	14	142
Clay, sandy	6	148
Clay	16	164
Sand	2	166
Clay	1	167
Sand	2	169
Clay	1	170
Sand (water)	9	179
Clay, white	14	193
Sandy, hard	9	202
Sand (water)	16	218
Clay	1	219
Sand (water)	15	234
Clay, red	41	275
Sandy	8	283
Clay, hard	1	284
Sand (water)	14	298
Clay, white	4	302
Sand (water)	16	318
Sand and gravel	8	326

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Arundel clay:		
Clay, white	45.5	371.5
Clay	2	373.5
Rock	.5	374
Patuxent formation:		
Sandy with wood	27.3	401.3
Rock, hard	.5	401.8
Sandy	4.2	406
Rock, hard	.3	406.3
Sand with clay	14.7	421
Rock	.3	421.3
Sandy	22.5	443.8
Rock	.2	444
Hard place, several rocks	18.4	462.4
Rock, hard	.3	462.7
Clay, sandy	9.7	472.4
Rock	.3	472.7
Clay	1	473.7
Rock, hard	.3	474
Clay, hard, with boulders	22.8	496.8
Clay, hard	5.4	502.2
Rock, hard	.4	502.6
Clay, sandy	40.4	543
Clay, hard	16	559
Clay, red, hard	.3	559.3
Sand, free	1.7	561
Clay, sandy	2	563
Sand and gravel	4	567
Hard	13.7	580.7
Sand, free, red	4.2	584.9
Rock, hard	.3	585.2
Sandy	10.8	596
Clay, red, hard	1	597
Clay, gray	11	608
Sandy	11	619
Sand and wood	10	629
Harder	6.6	635.6
Sand, free	9.4	645
Gravel, hard	9	654
Free, not so much gravel	9	663
Gravel, tight, mostly sand	4.3	667.3
Gravel, hard	1.6	668.9
(Not reported)	8.1	677

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Bal-Gf 13		
Pleistocene deposits:		
Clay	18	18
Sand	32	50
Clay, blue	14	64
Gravel	11	75
Patapsco formation:		
Clay, streaked	1	76
Sand, free	28	104
Sand, some very hard	16	120
Sand, free	37	157
Sand and clay	8	165
Bal-Gf 15		
Pleistocene deposits:		
Clay	18	18
Sand	32	50
Clay, blue	14	64
Gravel	11	75
Patapsco formation:		
Clay	1	76
Sand, free	28	104
Sand, hard	16	120
Sand, free	37	157
Clay, sandy	8	165
Sand, free	10	175
Clay	10	185
Sand, free	1	186
Sand, hard	2	188
Sand, free	4	192
Clay, white	11	203
Sand, free	7	210
Clay, sandy	5	215
Sand, free	11	226
Bal-Gf 16		
Recent deposits:		
Slag	12	12
Pleistocene deposits:		
Clay, yellow	14	26
Gravel	1	27
Clay, dark gray	33	60
Clay, brown	40	100
Patapsco formation:		
Sandy	26	126

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Sand and gravel	7	133
Sand	8	141
Clay, hard	2	143
Sand, free	6	149
Clay, sandy	6	155
Clay, hard	6	161
Sand, free	3	164
Clay	6	170
Sandy	30	200
Sand, not very free (water)	17	217
Clay, hard	1.5	218.5
Sand	2.5	221
Sand, free (water)	10	231
Clay, red	23	254
Clay, soft	4	258
Clay, harder	2	260
Sandy, soft; clay in streaks	36	296
Clay, white	4	300
Sand, some gravel	20	320
Arundel clay:		
Clay, red	20	340
Patuxent formation:		
Sandy	3	343
Sand (water)	27	370
Iron ore	1	371
Sandy (drifts)	4	375
Clay, lead color	8	383
Boulder; clay, sandy	5	388
Boulder and clay	13.8	401.8
Boulder	.2	402
Soft	.4	402.4
Boulder	.3	402.7
Clay, soft	1.3	404
Clay, hard	12.5	416.5
Boulder	.7	417.2
Sand and clay streaks	58.8	476
Boulder	.3	476.3
Clay	3.7	480
Sand streaks	12.8	492.8
Boulder	.5	493.3
Clay, yellow; sand streaks	10.7	504
Clay, red, hard	2	506
Boulder	.3	506.3

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Clay	.7	507
Sand (drifts)	23	530
Sand, very free	8	538
Clay, red	5	543
Clay, yellow	3	546
Clay, gray	18	564
Sand	5.5	569.5
Clay and sand	2.5	572
Gravel and wood	6.5	578.5
Sand and clay crusts	6.5	585
Sand, gray, free; wood	15	600
Clay, gray	39	639
Sand, free	3	642
Sand and gravel	4	646
Gravel, hard	1	647
Sand and gravel, very free	13	660
Clay	1	661
Bal-Gf 17		
Pleistocene deposits:		
Clay, yellow	27	27
Clay, green, soft	20	47
Clay, green, harder	3	50
Clay, green, soft	16	66
Sand and gravel	3	69
Clay, green, soft	20	89
Patapsco formation:		
Clay, gray, harder	44	133
Clay, red, hard	10	143
Sand, white	2	145
Clay, white	10	155
Sand, white	18	173
Clay, white	16	189
Sand, white; clay in streaks	27	216
Clay, white	5	221
Sand	9	230
Sand, fine	10	240
Clay, red	36	276
Clay, sandy	15	291
Sand and gravel	3	294
Clay, sandy	2	296
Sand and gravel	7	303
Clay, sandy	3	306

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Sand and gravel	7	313
Sand, hard	2	315
Sand and gravel	8	323
Clay, white		323
Bal-Gf 36		
Pleistocene deposits:		
Clay	40	40
Sandy	10	50
Sand and gravel	30	80
Patapsco formation:		
Clay	10	90
Sand	112	202
Clay	5	207
Sand and gravel	11.7	218.7
Clay	.5	219.2
Sand and gravel	12.4	231.6
Clay		231.6
(Not reported)	63.4	295
Sand, free; hard at 298.4 feet	3.4	298.4
Gravel	4.6	303
Sand, free	5	308
Hard	2	310
Sand, free; crust at 317 feet	14	324
Gravel, not free	11.5	335.5
Arundel and Patuxent formations:		
Clay	10.3	345.8
Sandy	1.2	347
Clay	7.3	354.3
Hard	4.7	359
Drifts some	3.5	362.5
Clay, white, hard	1.5	364
Free	1	365
Clay	4	369
Free	2	371
Sand, free	3	374
Clay, hard	4	378
Sand, free	3.5	381.5
Crust, hard	.5	382
Clay, sandy	1	383
Clay, tough	.8	383.8
Sand, free	.8	384.6
Clay, tough	11	395.6
Clay, softer	10.4	406
Sand, free	1.5	407.5

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Sand or clay, soft	.5	408
Boulder, hard	.5	408.5
Sandy	1.5	410
Sand, very free	2	412
Sand	2	414
Clay, sandy	2	416
Clay	1.5	417.5
Sand, free	1	418.5
Sandy	.5	419
Clay	1	420
Rock, hard	.3	420.3
Rock, very hard	.1	420.4
Sandy, free in places	3.1	423.5
Clay	1	424.5
Sand and clay	2	426.5
Sand, free	1	427.5
Clay, sandy	.3	427.8
Sand, free	.9	428.7
Clay, sandy	.6	429.3
Sand, free; clay streaks	3.2	432.5
Clay	1.5	434
Sand, free	1	435
Clay	.5	435.5
Clay, sandy	2.5	438
Sand and gravel, free in places	2.5	440.5
Sand, very free; some gravel	5	445.5
Rock, hard	.8	446.3
Clay	3.4	449.7
Rock, hard	.5	450.2
Sand; clay	7.6	457.8
Hard place	.5	458.3
Clay, tough	11.7	470
Sandy; clay streaks	10	480
Clay, hard	23	503
Clay, softer	3	506
Hard place	.5	506.5
Very sandy	2	508.5
Hard; sandy places	12	520.5
Hard	5.2	525.7
Sand, tight	1	526.7
Clay, yellow, tough	5.3	532
Clay, sandy, white	2	534
Clay, white, tough	13	547

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Sandy	6.8	553.8
Rock	.2	554
Clay, red, hard	16.5	570.5
Sand, free, coarse	10	580.5
Clay, red, hard	3	583.5
Gravel, tight	2	585.5
Gravel, free	4	589.5
Gravel, tight	1	590.5
Clay, white	1	591.5
Gravel, tight	1.5	593
Sand and hard	4.3	597.3
Clay	.6	597.9
Sand and hard	7.6	605.5
Clay, hard	4.7	610.2
Sand and hard	1.3	611.5
Clay, red, hard	13.3	624.8
Sandy and stone	.4	625.2
Clay	1.3	626.5
Sand, free, and gravel	2.5	629
(Not reported)	56	685
Bal-Gf 45		
Pleistocene deposits:		
(Not reported)	8	8
Clay, blue	117	125
Sand	5	130
Sand and gravel	7	137
Patapsco formation:		
Clay, white	10	147
Sand	13	160
Sand and gravel	16	176
Clay, white	14	190
Sand	4	194
Gravel	5	199
Clay, white	4	203
Sand and gravel	5	208
Clay, red	64	272
Sand and gravel	16	288
Bal-Gf 47		
Pleistocene deposits and Patapsco formation:		
(Not reported)	215	215
Clay, red	53.5	268.5

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Clay, lead-colored	17.2	285.7
Sandy	10.7	296.4
Arundel clay:		
Clay, sandy	15.6	312
Clay, harder	15.4	327.4
Hard place	.6	328
Clay, red; 1 foot of sand at 366 feet	39.9	367.9
Boulder	.2	368.1
Patuxent formation:		
Sand, free	6.2	374.3
Clay, sandy	14.7	389
Sand	2	391
Clay	.5	391.5
Sand	2.5	394
Clay	.5	394.5
Sand, free	9.5	404
Clay	4	408
Sand, free	24.7	432.7
Bal-Gf 49		
Recent deposits:		
Ashes	6	6
Pleistocene deposits:		
Mud, soft	101	107
Sand	13	120
Sand and gravel	15	135
Patapsco formation:		
Sand	79	214
Clay, red	46	260
Sand (water)	20	280
Clay, sandy	15	295
Arundel clay:		
Clay	63	358
Patuxent formation:		
Sand (water)	15	373
Clay, sandy	1	374
Sand (water)	31	405
Sand and gravel	19	424
(Not reported)	60	484
Bal-Gf 53		
Pleistocene deposits and Patapsco formation:		
(Not reported)	150	150

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Clay	40	190
Sand and gravel	20	210
Clay, sandy	5	215
Clay, red	53.5	268.5
Clay, lead-colored	17.2	285.7
Sandy	10.7	296.4
Arundel clay:		
Clay, sandy	15.6	312
Clay, harder	15.4	327.4
Hard place	.6	328
Clay, red	39.9	367.9
Boulder	.2	368.1
Patuxent formation:		
Sand, free	6.2	374.3
Clay, sandy	14.7	389
Sand	2	391
Clay	.5	391.5
Sand	2.5	394
Clay	.5	394.5
Sand, free	26.5	421
Sand	1.3	422.3
Clay	2	424.3
Sand; clay in streaks	15.9	440.2
Clay streaks	15.4	455.6
Iron ore	.4	456
Sand streaks	5	461
Iron ore, hard	.3	461.3
Clay, hard; sand in streaks	20	481.3
Iron ore	.4	481.7
Sand and clay	2.3	484
Clay, hard	32.7	516.7
Iron ore, in streaks; boulder, hard	.1	516.8
Softer	3.2	520
Sand, free in places	20	540
Clay, hard	4	544
Sand, part free	13.3	557.3
Hard; sand streaks	5	562.3
Clay, red, hard	1	563.3
Sand	2	565.3
Edge of boulder; clay, red; iron ore	14.7	580
Boulder	.2	580.2
Clay	10.5	590.7
Sandy, free in places; wood	25.3	616

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Clay, hard	4	620
Sand, free; gravel	2	622
Sand, free	5.6	627.6
Clay	1	628.6
Sand	2.4	631
Clay	1.8	632.8
Sand	10	642.8
Sand, free	12.2	655
Gravel	4	659
Clay, white	1	660
Gravel, hard	7.4	667.4
Bal-Gf 71		
Pleistocene deposits:		
Clay, blue-black, very soft	117	117
Gravel (water)	18	135
Patapsco formation:		
Clay, white	10	145
Clay, sandy	30	175
Sand and gravel (water)	19	194
Bal-Gf 72		
Pleistocene deposits:		
(Not reported)	10	10
Clay, yellow, tough	25	35
Clay, dark, soft	75	110
Shell bed, ferruginous	7	117
Sand and clay, alternate (water)	23	140
Patapsco formation:		
Clay	45	185
Sand and gravel (water)	19	204
Clay, sandy, white	7	211
Clay, deep red	6	217
Sand and gravel, red (water)	8	225
Clay, light brown	60	285
Sand, creamy (water)	13	298
Clay, red	2	300
Sand; red clay at 302 feet	2	302
Bal-Gf 74		
Pleistocene deposits:		
Made ground, yellow	9	9
Clay, dark drab, tough	19	28

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Clay, dark drab, soft	78	106
Clay, sandy, dark drab, hard	1	107
Clay, sandy, dark drab, soft	2	109
Clay, sandy, dark drab, hard	7	116
Sand, yellow, soft	12	128
Gravel, yellow, soft	6	134
Patapsco formation:		
Sand, white, soft	26	160
Clay, sandy, white, soft	15	175
Sand, white, soft	23	198
Clay, white, tough	10	208
Sand, white, not free	12	220
Clay, sandy, white, soft	3	223
Sand and gravel, red, free	2	225
Clay, red, hard	5	230
Clay, brown, soft (boulder at 255 feet)	32	262
Clay, gray, hard (boulder at 263 feet)	18	280
Clay, red, hard	3	283
Sand, white, free	13	296
Clay, pink, hard	3	299
Gravel, red, free	4	303
Clay, pink, soft	5	308
Sand, white, free	8	316
Arundel clay:		
Clay, red, very hard	4	320
Clay, brown, softer	30	350
Clay, yellow	25	375
Clay, red and gray, hard and soft	33	408
Patuxent formation:		
Sand, red, free	7	415
Clay, sandy, red, soft	13	428
Sand, white	3	431
Clay, light drab, soft	4	435
Clay, red, very hard	23	458
Clay, light brown, very hard	5	463
Clay, light blue, very hard	14	477
Clay, bright red, hard	1	478
Sand, white	1	479
Sand and gravel	16	495

Bal-Gf 75		
Recent deposits:		
Fill	6	6

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Pleistocene deposits:		
Clay, dark gray	119	125
Sand	11	136
Sand and gravel	9	145
Patapsco formation;		
Sand	10	155
Clay, sandy, white	22	177
Sand, free	13	190
Clay	3	193
Sand and gravel	10	203
(Not reported)	7	210
Bal-Gf 78		
Recent deposits:		
Fill	10	10
Pleistocene deposits:		
Clay, lead-colored	20	30
Sandy	30	60
Clay	65	125
Gravel	15	140
Patapsco formation:		
Sandy	45	185
Clay	20	205
Sandy	20	225
Clay, hard	25	250
Rock	1	251
Clay, hard	29	280
Clay, white, tough	5.5	285.5
Sand, free	7.5	293
Gravel, free; clay in streaks	8	301
Arundel clay:		
Clay, red, hard	.5	301.5
Clay, blue, tough	63.5	365
Rock	.3	365.3
Clay	15.2	380.5
Rock	.5	381
Clay, softer	17	398
Patuxent formation:		
Very sandy	17	415
Clay	2	417
Sand	2	419
Sand, free	5	424
Clay, tough	.5	424.5

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
(Not reported)	4.5	429
Free	6	435
Tough	3.5	438.5
Sandy	18.5	457
Clay	5	462
Sand	1	463
Clay	1	464
Free	2	466
Clay	10	476
Clay, sandy	6	482
Sand; some wood; some gravel	5	487
Clay	.5	487.5
Sand, free	.5	488
Clay, hard	1	489
Sand, free	1	490
Clay	7	497
Sand; some gravel	2	499
Clay	2	501
Clay, hard	1.5	502.5
Sand, free	.5	503
Clay, hard	13.5	516.5
Rock	.5	517
Clay	6	523
Sandy	3.5	526.5
Rock	.3	526.8
(Not reported)	.7	527.5
Rock	4	531.5
Sandy, with hard places	6.5	538
Clay, tough	2	540
Hard places	8	548
Clay	2.5	550.5
Rock	.3	550.8
Clay, hard	10.2	561
Sand, hard	1	562
Clay	2	564
Sand	3	567
Rock	1.7	568.7
Clay, hard	9.8	578.5
Sand	1.5	580
Clay	9	589
Sandy	1	590
Clay, lead-colored	11	601

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Sand	1	602
Clay	14.3	616.3
Drifted	2.7	619
Gravel	5	624
Hard	.5	624.5
Sand and gravel, free	4.5	629
Clay, tough	9.3	638.3
Clay	1.2	639.5
Hard	.3	639.8
Gravel	14.7	654.5
Bal-Gf 100		
Pleistocene deposits:		
Clay, yellow	30	30
Sand, gray	15	45
Clay, dark gray	65	110
Clay, light gray	10	120
Sand and gravel	15	135
Patapsco formation:		
Clay, sandy, white	8	143
Sand, white (water)	14	157
Clay, white	6	163
Sand, white (water)	23	186
Clay, sandy	4	190
Sand and gravel	6.5	196.5
Clay, white	2.5	199
(Not reported)	85	284
Bal-Gf 105		
Pleistocene deposits and Patapsco formation:		
(Not reported)	8	8
Clay	22	30
Sand	15	45
Clay	72	117
Hard	9	126
Clay, white, with streaks of sand	38.1	164.1
Clay streaks	58.5	222.6
Clay, red	40.1	262.7
Sand	27.3	290
Clay, in streaks	1.5	291.5
Sand	2.2	293.7
Clay, white	.5	294.2
Sand	1.3	295.5

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Clay	2	297.5
Gravel	1.6	299.1
Clay	.7	299.8
Gravel	8.2	308
Clay	4	312
Sand	4	316
Arundel clay:		
Clay	63.1	379.1
Hard place	.7	379.8
Clay	17.2	397
Clay, in streaks	20	417
Harder	36.5	453.5
Patuxent formation:		
Sand	3	456.5
Hard	21.5	478
(Not reported)	6.9	484.9
Sandstone (?), hard	.5	485.4
Boulder	.4	485.8
Soft	.6	486.4
Soft, hard streaks	.9	487.3
Boulder	.4	487.7
Softer	.6	488.3
Boulder	.7	489
Soft	.7	489.7
Hard	2.3	492
Soft	1.3	493.3
(Not reported)	4.7	498
Sand	8.8	506.8
Gravel	3.4	510.2
Clay	5	515.2
Sandy	.5	515.7
Sand, free	22.6	538.3

Bal-Gf 109		
Recent deposits:		
Slag	15	15
Pleistocene deposits:		
Clay, yellow	10	25
Clay, sandy, yellow	30	55
Patapsco formation:		
Clay, red	38	93
Clay, yellow	8	101
Clay, red	36	137

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Clay, brown	12	149
Sand, free	5	154
Clay, sandy, white	4	158
Sand, white (water)	14	172
Bal-Gf 110		
Recent deposits:		
Slag	15	15
Pleistocene deposits:		
Clay, yellow	14	29
Clay, sandy, yellow	37	66
Patapsco formation:		
Clay, red, brown, and white	74	140
Clay, lead-colored	10	150
Clay, sandy, white	5	155
Sand, white, free	19	174
Clay, sandy, pink	10	184
Sand (water)	13	197
Clay, sandy, white	16	213
Sand and gravel (water)	15	228
Clay		228
Bal-Gf 111		
Recent deposits:		
Slag	15	15
Pleistocene deposits:		
Clay, yellow	13	28
Clay, sandy, yellow	44	72
Patapsco formation:		
Clay, red	29	101
Clay, brown	52	153
Sand (water)	15	168
Clay, sandy, hard	15	183
Sand (water)	13	196
Clay, sandy, red and white	18	214
Sand and gravel (water)	8	222
Bal-Gf 112		
Recent deposits:		
Slag	15	15
Pleistocene deposits:		
Clay, yellow	13	28
Clay, sandy, yellow	44	72

TABLE 16- -*Continued*

	Thickness (feet)	Depth (feet)
Patapsco formation:		
Clay, red	29	101
Clay, brown	52	153
Clay, sandy, white	4	157
Sand (water)	15	172
Bal-Gf 113		
Recent deposits:		
Slag	15	15
Pleistocene deposits:		
Clay, yellow	13	28
Clay, sandy, yellow	41	69
Patapsco formation:		
Clay, red	25	94
Clay, brown	7	101
Clay, red	51	152
Clay, sandy, white	7	159
Sand (water)	13	172
Bal-Gf 114		
Recent deposits:		
Slag	15	15
Pleistocene deposits:		
Clay, yellow	13	28
Clay, sandy, yellow	41	69
Patapsco formation:		
Clay, white	21	90
Clay, red	10	100
Clay, brown	8	108
Clay, red	45	153
Clay, sandy, white	6	159
Sand (water)	37	196
Clay, sandy, red and white	18	214
Sand and gravel (water)	16	230
Bal-Gf 115		
Recent deposits:		
Slag	15	15
Pleistocene deposits:		
Clay, yellow	13	28
Clay, sandy, yellow	40	68
Patapsco formation:		
Clay, red	82	150

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Sand, white	2	152
Clay, red	3	155
Sand (water)	16	171
Clay, white	13	184
Sand, white	12	196
Clay, white	10	206
Sand	3	209
Clay, red	1	210
Sand, white (water)	4	214
Sand, hard	2	216
Clay, white	1	217
Sand and gravel	5	222
(Not reported)	52	274
Bal-Gf 116		
Recent deposits:		
Slag	15	15
Pleistocene deposits:		
Mud, black	3	18
Clay, yellow	7	25
Clay, sandy, yellow	50	75
Patapsco formation:		
Clay, red	1	76
Clay, white	14	80
Clay, yellow	18	108
Clay, red	45	153
Sand, white (water)	26	179
Bal-Gf 134		
Pleistocene deposits:		
(Not reported)	30	30
Clay, blue	10	40
Patapsco formation:		
Sand; clay, white, in streaks	44	84
Sand, very fine	12	96
Clay, white	2	98
Sand	6	104
Clay, sandy	12	116
Sand, free	2	118
Clay, red	22	140
Sand	59	199
Clay	5	204
Sand	9	213

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Clay	1	214
Sand	2	216
Clay	2	218
Sandy	6	224
Gravel	4	228
Clay, red	23	251
Iron ore	.2	251.2
Sand	28.8	280
Bal-Gf 135		
Pleistocene deposits and Patapsco formation:		
(Not reported)	15	15
Clay	15	30
Sand	60	90
Clay	22	112
Sand	84	196
Clay, sandy	27	223
Clay, red	29	252
Sand (water)	42	294
Clay	1	295
Sand	13	308
Arundel clay:		
Clay	126	434
Patuxent formation:		
Sand	7	441
Clay	2	443
Sand (water)	14	457
Clay	23	480
Sand	2	482
Clay	5	487
Sand and gravel	27	514
Bal-Gf 138		
Recent deposits:		
Slag	8	8
Pleistocene deposits:		
Sand	4	12
Clay, yellow	18	30
Sandy	20	50
Patapsco formation:		
Hard place	.5	50.5
(Not reported)	94.5	145
Sand	29	174
Clay, sandy	4	178
(Not reported) (Hard at 214 and 220 feet)	42	220
Clay streak	2	222
Clay	31	253
Sand	43	296

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Bal-Gf 139		
Pleistocene deposits and Patapsco formation:		
(Not reported)	246.8	246.8
Sand	60.1	306.9
Boulder	.5	307.4
Sandy	3.6	311
Arundel clay:		
Clay	44	355
Patuxent formation:		
Very sandy	2	357
Clay	1	358
Sandy	1	359
Clay	10.6	369.6
Sand, soft	5	374.6
Hard place	.4	375
Clay	35	410
Hard place	1.7	411.7
Sand	1.3	413
Hard place	1.2	414.2
Sand, free	7.8	422
Harder	4	426
Sand, free	3.7	429.7
Harder	.5	430.2
Sand, free	5.8	436
Harder	1	437
Sandy	2	439
Harder	9	448
Sand and clay; iron ore	16	464
Sand, white, free, fine	12	476
Sand, not as free	13	489
Gravel, free	5	494
Clay	1	495
Clay, sandy	4	499
Gravel, free	1	500
Clay, sandy	17	517
Gravel, free	22	539
Clay	4	543
Sandy	3	546
Sand, free	1	547
Clay	5	552
Sandy	3.7	555.7
Crust	3	558.7
Sand, free	5	563.7

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Clay	1	564.7
Free	15.3	580
Clay	1.5	581.5
Sand	.5	582
Clay	4	586
Sand	.5	586.5
Clay	.5	587
Sand	37	624
Clay, white	2	626

Bal-Gf 161		
Pleistocene deposits:		
Clay, yellow	20	20
Clay, blue	10	30
Sand, green	15	45
Clay, blue	55	100
Sand and gravel, white	28	128
Patapsco formation:		
Clay, red and white	18	146
Clay, sandy, white	19	165
Sand, white	39	204
Sand, white, coarse	16	220
Clay, red	5	225
Sand and gravel	9	234
Clay, red	16	250
Sand and gravel, coarse	31	281
Clay, sandy, white	19	300
Clay, red	3	303
Sand, white, coarse	10	313
Arundel clay:		
Clay, red	3	316
Clay, sandy, red	3	319
Clay, brown	2	321
Clay, pink, tough	3	324
Clay, pink and white, tough	41	365
Clay, brown	29	394
Patuxent formation:		
Sand, white	5	399
Clay, pink, hard	.5	399.5
Sand, white	.5	400
Clay, red	7	407
Clay, brown; sand	5	412
Clay, red, tough	2	414

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Clay, sandy, red	17	431
Sand, white, free	3	434
Clay, sandy, red	16	450
Clay, red, very hard	10	460
Sand, in streaks	1	461
Clay, red, very hard	3	464
Clay, yellow, hard	5	469
Clay, red, very hard	1	470
Clay, red, tough	7	477
Clay, pink, tough	5	482
Sand, white	1	483
Clay, red	7	490
Clay, red, very hard	3	493
Clay, sandy, red	3	496
Rock	.3	496.3
Clay, sandy, pink	2.7	499
Clay, pink	1	500
Clay, white	3	503
Sand, white, fine	7	510
Sand, white, coarse	5	515
Clay, red	3	518
Clay, white	10	528
Sand, white	3	531
Clay, sandy, white	4	535
Clay, pink, hard	1	536
Sand, white, free, coarse	40	576

Bal-Gf 162		
Pleistocene deposits:		
Sand	9	9
Clay, yellow	12	21
Clay, blue	14	35
Sand, gray	7	42
Clay, blue	59	101
Gravel	9	110
Patapsco formation:		
Clay, white	7	117
Clay, sandy, white	8	125
Clay, red	8	133
Clay, white	14	147
Sand, white	63	210
Sand and clay	26	236
Clay, red	19.5	255.5
Sand and gravel	32.5	288

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Bal-Gf 163		
Recent deposits:		
Ashes	3	3
Pleistocene deposits:		
Clay, yellow	18	21
Clay, blue	14	35
Sand, gray	7	42
Clay, blue	66	108
Gravel	7	115
Patapsco formation:		
Clay, white	6	121
Sand, white	9	130
Clay, white	20	150
Clay, sandy, white	10	160
Sand, white	30	190
Bal-Gf 171		
Pleistocene deposits:		
Clay, yellow	6	6
Sandy	4	10
Clay, dark	113	123
Sand and gravel	11	134
Patapsco formation:		
Sand, white	24	158
Sand, free in places	35	193
Clay, hard	3	196
Sandy	3.5	199.5
Sand, free	20.5	220
Clay	.5	220.5
Sand, free	4.5	225
Clay	2	227
Clay, harder	5	232
Sand	11	243
Clay, hard	5	248
Sand, free	7	255
Clay	1	256
Sand, not free	14	270
Clay, hard	2	272
Sand, free in places	28	300
Sandy	38.6	338.6
Clay	2.4	341
Sand and gravel	2	343

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Arundel clay:		
Clay, red, hard	146	489
Patuxent formation:		
Clay, red, softer	10	499
Clay, red, hard	11	510
Sand and clay	2	512
Clay, hard	.5	512.5
Clay, harder	46.5	559
Clay, red	28	587
Clay, sandy; with streaks of free sand and wood	7.8	594.8
Hard	1	595.8
Sandy	8.1	603.9
Sandy, free	6	609.9
Sand (little water)	6	615.9
Clay	1.7	617.6
Sand, free	4	621.6
Clay, hard	6.2	627.8
Clay, harder	31.2	659
Clay, softer	21	680
Sand, free	12.2	692.2
Hard place	4	696.2
Gravel	9.8	706

Bal-Gf 174		
Pleistocene deposits:		
Clay, yellow	6	6
Sandy	4	10
Clay, dark	114	124
Sandy	3	127
Sand and gravel	13	140
Patapsco formation:		
Sand	20	160
Sand, free in places	35	195
Clay, hard	3	198
Sandy	3	201
Sand, free	20	221
Clay	1	222
Sand, free	4	226
Clay	7	233
Sand	11	244
Clay	5	249
Sand, free	11	260

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Clay	7.3	267.3
Sand	54.7	322
Bal-Gf 177		
Pleistocene deposits:		
River deposits	74	74
Patapsco formation:		
Clay, red	84	158
Sand	20	178
Clay, sandy, white	61	239
Clay, red	35	274
Clay, yellow and brown	39	313
Sand and gravel	121	434
Arundel and Patuxent formations:		
Clay, red	56	490
Sand	14	504
Clay, sandy	8	512
Clay, red, tough	148	660
Clay, sandy, light	61	721
Sand (water)	22	743
Bal-Gf 180		
Pleistocene deposits:		
(Not reported)	10	10
Clay, yellow	15	25
Sand	5	30
Clay, blue	35	65
Patapsco formation:		
Clay, red, tough	10	75
Clay, red, very tough	66	141
Clay, sandy, blue	108	249
Clay, sandy, red	22	271
Sand; clay, blue	21	292
Sand, coarse	12	304
Sand and clay	18	322
Sand, gravel, and some clay	30	352
Sand and gravel	43	395
Arundel clay:		
Clay, red, hard	15	410
Bal-Gf 186		
Pleistocene deposits:		
Clay, brown, hard	11	11

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Sand, brown, soft	2	13
Clay, blue, soft	127	140
Gravel	7	147
Patapsco formation:		
Sand, white, soft	49	196
Sand, white, hard (some clay with the sand)	40	236
Sand, white, soft (water)	17	253
Sandstone	7	260
Clay, red, sticky, soft	38	298
Clay, brown, hard	6	304
Clay, white, hard (some wood in clay)	15	319
Sand, light brown, soft	14	333
Clay, red, hard	38	371
Sand, white, soft	31	402
Bal-Gf 187		
Pleistocene (?) deposits:		
(Not reported)	21	21
Sand	4	25
Clay	10	35
Sand, free	5	40
Patapsco formation:		
Clay, red	57	97
Clay, sandy	13.4	110.4
Sand	9.5	119.9
Bal-Gf 193		
Pleistocene deposits:		
Clay, brown	22	22
Sand	1	23
Clay, gray and blue	29	52
Sand	2	54
Clay, blue	7	61
Clay, blue, with shells	15	76
Clay, blue	32	108
Sand and gravel	13	121
Patapsco formation:		
Clay, white	11	132
Sand and gravel	4	136
Clay, sandy, white	2	138
Sand	34	172
Clay, sandy	4	176
Sand and gravel	4	180

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Clay, sandy	16	196
Clay, white	11	207
Clay, sandy	19	226
Sand	4	230
Clay, white	2	232
Sand, coarse	2	234
Clay, sandy	3	237
Sand	3	240
Clay, sandy, white	10	250
Sand, free	23	273
Clay, red, hard	13	286
Sand, free (water)	9	295
Sand, coarse	5	300
Sand, free	12	312
Clay, hard	4	316
Sand, coarse	4	320
Sand, free	1	321
Clay	2	323
Sand	2	325
Clay	1	326
Sand	6	332
Clay	1	333
Sand	3	336
Arundel clay:		
Clay, red	4	340
Sand	1	341
Clay	4	345
Bal-Gf 194		
Pleistocene deposits:		
Clay, brown	20	20
Clay, gray	15	35
Sand	5	40
Clay, gray; few shells	31	71
Sand and gravel	12	83
Clay, gray	7	90
Sand and gravel, free	11	101
Sand and gravel	2	103
Clay, gray	12	115
Sand and gravel	17	132
Patapsco formation:		
Clay or cemented gravel	8	140
Clay, sandy, white; mixed gravel	8	148

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Clay, white	5	153
Sand, hard	3	156
Sand; clay streaks	2	158
Sand	3	161
Clay, sandy	7	168
Gravel	6	174
Sand	2	176
Sand and gravel, coarse	2	178
Clay, sandy, white	1	179
Clay	8	187
Sand, fine	2	189
Clay, white	7	196
Sand, free	2	198
Clay, sandy	2	200
Sand	9	209
Clay, white, hard	2	211
Clay, sandy	2	213
Sand	4	217
Clay, sandy	2	219
Sand and clay	5	224
Clay, red, gray, and white	64	288
Sand	2	290
Clay, sandy	4	294
Clay, sandy, white	2	296
Clay, sandy	5	301
Clay, sandy; hard place	4	305
Sand, fine; little white clay	3	308
Sand	4	312
Clay, hard; gravel, fine	3	315
Arundel clay:		
Clay, red	12	327
Bal-Gg 1		
Pleistocene deposits:		
Sand, fine	8	8
Clay, gray; quicksand	32	40
Patapsco formation:		
Clay, red	60	100
Sand, fine	10	110
Clay, light red	1	111
Sand, fine	9	120
Clay, light yellow	1	121
Sand, fine	10	131

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Sand, white, mixed with small gravel and small pieces of white clay	11	142
Sand, white	38	180
Clay, red	1	181
Sand, white	2	183
Clay, yellow	1	184
Sand, coarse	1	185
Bal-Gg 2		
Pleistocene deposits and Patapsco formation:		
"Marsh mud"	4	4
Sand	4	8
Clay, gray	1	9
Clay, red	20	29
Clay, pink	7	36
Clay, orange	1	37
Clay, salmon-yellow	2	39
Clay, dark yellow	3	42
Clay, light yellow	7	49
Clay, light brown	6	55
Clay, dark gray	4	59
Clay, light tan	5	64
Clay, light yellow	7	71
Clay, light red	8	79
Clay, pink	4	83
Clay, light red	6	89
Clay, orange	2	91
Clay, red	12	103
Clay, brown	23	126
Loam, brown	4	130
Clay, orange	4	134
Clay, yellow	3	137
Sand, fine	8	145
Clay, yellow	2	147
Sand, mixed with charcoal	8	155
Sand, white, mixed with clay	29	184
Clay, white	1	185
Sand, white, fine	1	186
Clay, brown	1	187
Sand, white, fine	1	188
Clay, red	1	189
Sand, white, fine	1	190
Clay, yellow	2	192

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Sand, white, fine	2	194
Clay, white	3	197
Sand, white, fine	2	199
Clay, light yellow	3	202
Sand, white, fine	9	211
Sand, coarse	3	214
Har-Cf 2		
Pleistocene deposits:		
Sand, silty	8	8
Sand and gravel, dirty	19	27
Sand, coarse, dirty	3	30
Sand and gravel	6	36
Gravel, coarse	2	38
Gravel, quartz, large (1 to 2 inches in diameter)	4	42
Gravel	2	44
Clay	3	47
Sand	3	50
Sand, quartz, coarse	2	52
Sand	2	54
Sand, quartz, coarse; rock at 58 feet	4	58
Har-Dc 1		
Cretaceous sediments:		
Clay	135	135
Ironstone	.7	135.7
Clay	24.3	160
Pre-Cambrian rocks:		
Rock	130	290
Har-Dd 4		
Cretaceous sediments:		
Gravel	2	2
Clay, yellow	8	10
Clay, red	85	95
Clay, blue	30	125
Sand (little water); rock at 126.5 feet	1.5	126.5
Pre-Cambrian rocks:		
Har-Dd 5		
Pleistocene and Cretaceous sediments:		
Soil	4	4

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Clay, yellow	56	60
"Quicksand"	10	70
Clay, red	38	108
Gravel, cemented	2	110
Sand, fine	3	113
Sand and gravel	3	116
Har-De 3		
Cretaceous sediments:		
Clay, yellow	6	6
Clay, blue	18	24
Clay, yellow	6	30
Clay, blue; gravel	11	41
Clay, yellow	7	48
Clay, red	17	65
Clay, white and grayish	14	79
Sand, muddy (water)	14	93
Clay, sandy, pink and brown	12	105
Pre-Cambrian rocks:		
Rock, "rotten"	10	115
Granite, gray	230	345
Har-De 6		
Pleistocene deposits:		
Clay	8	8
Sand, light brown, medium to coarse; some gravel and clay	13	21
Sand, brown, fine; clay	26	47
Clay, blue	4	51
Sand and gravel, coarse, sharp (water)	28	79
Clay, brown	4	83
Har-De 7		
Pleistocene deposits:		
Clay and sand	10	10
Sand and sandrock, brown	18	28
Sand, yellow	21	49
Sandrock, brown	5	54
Sand and gravel, coarse (water)	17	71
Sand, white, coarse	6	77
Clay, red and gray	44	121

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Har-De 10		
Pleistocene deposits:		
Sand	50	50
Gravel	2	52
Har-De 18		
Pleistocene deposits:		
Clay, hard	10	10
Sand	27	37
Sand, light gray, medium	13	50
(Not reported)	1	51
Sand, coarse	1	52
(Not reported)	2	54
Gravel	1	55
Sand, buff, medium; few pieces of gravel	6	61
Har-De 19		
Pleistocene deposits:		
Sand and clay	5	5
Clay, sandy, brown	9	14
Clay, sandy, brown; shale, limy	6	20
Clay, sandy, brown; shale, limy; gravel, fine	11.5	31.5
Hardpan	10.5	42
Rock, hard; silt, yellow, in layers	4	46
Rock, hard; sand, coarse	2.5	48.5
Sand, coarse	8.5	57
Sand, yellow, coarse; clay, in layers	16	73
Hardpan; sand, coarse, in layers	5	78
Clay, brown, hard; silt, with indications of wood and mica	6	84
Clay, silty, red; rock, hard, in layers	52	136
Clay, red, hard; gravel, small	10	146
Cretaceous sediments:		
Clay, silty, red	10	156
Clay, red, hard; rock at 251.5 feet	95.5	251.5
Pre-Cambrian (?) rocks:		
Har-Df 7		
Pleistocene and Cretaceous sediments:		
Silt, mud, and surface debris	21	21
Gravel and sand, coarse	3	24
Sand and silt	7	31
Sand; some silt	10	41

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Clay	35	76
Sand and clay	58	134
Sand, hard; clay; gravel	5	139
Clay and gravel	47	186
Har-Df 8		
Pleistocene and Cretaceous sediments:		
Silt	11	11
Sand and silt	15	26
Sand; gravel, fine	6	32
Gravel and sand, coarse	18	50
Silt and sand	10	60
Sand, fine; silt	30	90
Sand	6	96
Sand, coarse; silt	12	108
Silt and clay	33	141
Sand, fine	8	149
Gravel; sand, coarse; silt	8	157
(Not reported)	5	162
Har-Df 9		
Pleistocene and Cretaceous sediments:		
Clay, silt, sandy, fine	14	14
Sand and gravel	4	18
Silt	49	67
Sand, hard packed	8	75
Clay	5	80
Sand	3	83
Sand, hard packed	4	87
Clay, sandy	6	93
Clay	40	133
Sand, hard	4	137
Sand	2	139
Sand, hard	5	144
Sand	2	146
Sand, hard	2	148
Rock	4	152
Clay, red, mixed with gravel	20	172
Har-Df 10		
Pleistocene and Cretaceous sediments:		
Silt and surface debris	15	15
Sand	5	20

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Sand, fine; silt	6	26
Sand	5	31
Sand, coarse	4	35
Silt, hard; sand; clay	16	51
Clay and some sand	14	65
Sand, coarse; some clay	6	71
Silt, sand, and clay	73	144
Silt, hard	5	149
Sand, fine	13	162
Clay, red; gravel	8	170
Har-Df 11		
Pleistocene deposits:		
Clay and silt	15	15
Sand and gravel	5	20
Gravel and sand, coarse	5	25
Silt and sand	3	28
Sand, coarse	5	33
Gravel and sand, coarse	22	55
Sand, fine; silt	12	67
Silt, sand, and clay	2	69
Sand and clay	4	73
Silt	15	88
Sand, fine	7	95
Har-Df 13		
Pleistocene and Cretaceous sediments:		
Sand and clay	5	5
Clay, red	8	13
Sand, yellow; boulders	10.5	23.5
Clay, silty, sandy, blue	44	67.5
Sand and clay, blue, in layers	23.5	91
Sand and gravel, white, coarse	24	115
Har-Df 14		
Pleistocene and Cretaceous sediments:		
Sand and clay	5	5
Sand and gravel, brown	3	8
Sandstone, brown	11.5	19.5
Sandstone	2.5	22
Sand, white	8.5	30.5

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Clay, sandy, blue	11.5	42
Sand, fine; clay; wood	21.3	63.3
Sand, white; gravel, in layers	42.2	105.5
Silt; clay, red	20.5	126
Har-Df 16		
Pleistocene and Cretaceous sediments:		
Clay, sandy, brown	10	10
Gravel, small	4	14
Gravel, fine; "pepper sand"	6	20
Sandstone	5	25
Boulders and gravel in clay	6.5	31.5
Clay, silty, yellow; gravel, fine; mica	18.5	50
Silt and mica	15	65
Hardpan	1	66
Clay, sandy, red	34	100
Har-Df 17		
Pleistocene and Cretaceous sediments:		
Clay, gray	12.3	12.3
Sand and gravel in 6-inch layers	4	16.3
Sand and gravel, coarse	16.5	32.8
Gravel	2.2	35
Wood and sand	7	42
Sand, blue; mica (hard to drill)	73.5	115.5
Clay, silty, gray; sand	39	154.5
Sand and gravel	10.5	165
Har-Df 20		
Pleistocene deposits:		
Sand and clay	4	4
Sand, brown; sandstone, in layers	10	14
Sand, brown; gravel, brown, coarse	6	20
Sand, yellow; hardpan at 36 feet and 39 feet.	21	41
Gravel, hard	19	60
Har-Df 22		
Pleistocene and Cretaceous sediments:		
Sand and water	5.3	5.3
Clay, brown; gravel in layers	5.7	11
Clay, sandy, red; traces of mica and limestone	5	16
Clay, sandy, brown, coarse; gravel	2.5	18.5
"Pepper sand," fine; gravel	5	23.5

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Gravel, coarse (water)	15.5	39
Sand, yellow, coarse; layers of gravel with traces of mica	20	59
Sand, silty, blue	4	63
Sandstone, brown	4.5	67.5
Clay, dark brown; mica	13	80.5
Clay, silty, gray; mica; wood	8.2	88.7
Sandstone and mica	9.7	98.4
Boulders	6.6	105
Har-Df 24		
Pleistocene deposits:		
Clay, red	5	5
Clay, sandy, red; gravel	15.5	20.5
Clay, sandy, red; gravel, coarse	12	32.5
Sand, yellow, fine; clay; gravel with traces of yellow clay	17.5	50
Sand and gravel, yellow	17	67
Har-Ed 1		
Pleistocene deposits and Patapsco formation:		
Soil	8	8
Clay, sandy	7	15
Sand and gravel (water)	18	33
Clay, red	6	39
Sand, gray	6	45
Clay, red	7	52
Clay, brown	6	58
Clay, gray	11	69
Clay, brown	27	96
Clay, red	14	110
Clay, gray	2	112
Sand and mica, white	14	126
Clay, brown	3	129
Har-Ed 2		
Pleistocene deposits and Patapsco formation:		
Clay, yellow	34	34
Sand, yellow (water)	4	38
Clay, red	33	71
Clay, brown	12	83
Clay, gray	43	126

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Har-Ed 3		
Pleistocene deposits and Patapsco formation:		
Clay and sand	5	5
Clay, light gray	21	26
Sand, white	2	28
Sand and gravel (water)	11	39
Clay, blue	6	45
Sand and gravel (water)	5	50
Clay, red	19	69
Sand, yellow	1	70
Clay, brown	11	81
Clay, gray	14	95
Sand, silty, fine	10	105
Clay, sandy, gray	21	126
Clay, gray, hard	1	127
Har-Ed 4		
Pleistocene deposits and Patapsco formation:		
Sand and clay, brown	10	10
Sand and clay, dark	10	20
Clay, yellow	6	26
Sand	4	30
Clay, very hard	15	45
Sand (water)	11	56
Clay, yellow	9	65
Sand (water)	5	70
Clay, blue	8	78
Sand	12	90
Har-Ed 5		
Pleistocene and Cretaceous sediments:		
Topsoil	4	4
Clay, sandy, blue	23	27
Clay, sandy, brown	4	31
Clay, sandy, blue	11	42
Clay, brown	8	50
Clay, sandy, red	10	60
Clay, sandy, red; wood	20	80
Clay, sandy, gray	18	98
Sand, gray	4	102
Clay, blue	17	119
Clay and sand	4	123
Clay, dark gray	17	140

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Clay, brown	28	168
Clay, sandy, gray and white	1	169
Sand, gray, fine	1	170
Clay, red	33	203
Sand and mica	13	216
Sand, fine; mica	4	220
Sand, coarse	2	222
Sand and gravel, fine	1	223
Clay, gray	1	224
Clay and wood	2	226
Har-Ed 6		
Pleistocene and Cretaceous sediments:		
Sand	35	35
Clay and boulders	95	130
Clay, hard	15	145
Sand (water)	30	175
Clay, blue	25	200
Sand (water)	15	215
(Not reported); rock at 364 feet	149	364
Pre-Cambrian rocks:		
Har-Ed 7		
Pleistocene deposits and Patapsco (?) formation:		
Sand and clay	10	10
Clay, brown	13	23
Clay, hard	17	40
Clay	5	45
Sand (water)	5	50
Clay, soft	18	68
Sand (water)	5	73
Har-Ed 8		
Pleistocene deposits and Patapsco formation:		
Sand	20	20
Sand, white	15	35
Sand and rock	5	40
Clay, gray	2	42
Clay, yellow	20	62
Clay, gray; sand; wood	23	85
Clay, gray	8	93
Sand and wood	7	100
Clay, gray; sand; wood	16	116
Clay, blue	9	125

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Har-Ed 9		
Pleistocene deposits and Patapsco formation.		
Sand and clay	5	5
Clay, gray	10	15
Sand, white	27	42
Clay, white	6	48
Sand (water)	7	55
Sand and clay	13	68
Sand (water)	2	70
Clay, blue	12	82
Sand and gravel (water)	23	105
Har-Ed 10		
Pleistocene deposits and Patapsco formation:		
Sand	19	19
Sand (water)	13	32
Sand and clay	5	37
Clay, blue	6	43
Sand, yellow	7	50
Sand, gravel, and clay	4	54
Sand, white	14	68
Clay, red	32	100
Clay, gray	37	137
Har-Ed 11		
Pleistocene deposits and Patapsco formation:		
Sand	5	5
Sand, yellow	21	26
Gravel	2	28
Sand, yellow	17	45
Clay, gray	27	72
Gravel (water)	3	75
Clay, gray	19	94
Clay, red	31	125
Clay, gray	14	139
Har-Ed 12		
Pleistocene deposits and Patapsco formation:		
Soil	3	3
Clay, yellow	11	14
Clay, sandy, gray	21	35
Clay, blue	31	66
Sand, white, fine	7	73

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Clay, sandy, gray	29	102
Clay, brown	19	121
Clay, white	4	125
Har-Ed 13		
Pleistocene deposits and Patapsco formation:		
Sand and clay	10	10
Clay, gray	23	33
Clay, blue	9	42
Clay, sandy, blue	3	45
Clay, blue	19	64
Sand, gray	8	72
Sand and gravel (water)	16	88
Clay, brown	14	102
Clay, red	11	113
Clay, brown	12	125
Har-Ed 14		
Pleistocene deposits and Patapsco (?) formation:		
Sand and clay	10	10
Clay, soft	25	35
Clay, hard	13	48
Clay, soft	7	55
Sand (water)	5	60
Clay, blue	10	70
Sand	10	80
Har-Ed 15		
Pleistocene and Cretaceous sediments:		
Sand and clay	20	20
Clay, soft	30	50
Sand, brown	20	70
Sand, white	20	90
Clay, hard	50	140
Sand (water)	25	165
Gravel and clay	20	185
Sand (water)	5	190
Clay, yellow	155	345
Sand (water)	20	365
Har-Ed 16		
Pleistocene deposits and Patapsco formation:		
Sand	15	15

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Clay, red	35	50
Sand, yellow	19	69
Sand and gravel (water)	9	78
Sand, gravel, and clay (water)	17	95
Clay, gray	20	115
Sand and wood (water)	3	118
Clay, red	17	135
Har-Ed 17		
Pleistocene deposits and Patapsco formation:		
Soil	2	2
Clay, yellow	13	15
Clay, brown	6	21
Clay, white	14	35
Sand, gray	5	40
Clay, sandy, gray	5	45
Sand, gray	26	71
Clay, gray	21	92
Sand, gray	3	95
Clay, gray	14	109
Clay, brown	16	125
Har-Ed 18		
Pleistocene deposits and Patapsco formation:		
Sand and clay	20	20
Clay, red	20	40
Clay, brown	40	80
Sand, yellow	10	90
Sand and gravel (water)	20	110
Sand, coarse (water)	10	120
Clay, gray	20	140
Har-Ed 19		
Pleistocene deposits and Patapsco formation:		
Clay, black	30	30
Sand, yellow (water)	6	36
Clay, red	14	50
Clay, white	12	62
Clay, black	21	83
Sand, white	19	102
Sand and gravel (water)	19	121
Clay, gray	5	126

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Har-Ed 20		
Pleistocene deposits and Patapsco formation:		
Sand and clay	30	30
Clay, red, hard	25	55
Clay, gray	23	78
Sand, white (water)	14	92
Clay, gray	6	98
Sand and gravel (water)	19	117
Clay, gray	22	139
Har-Ed 21		
Pleistocene deposits and Patapsco formation:		
Clay, red	28	28
Clay, brown	38	66
Clay, sandy, white	24	90
Sand, white, soft	16	106
Sand and gravel	15	121
Clay, gray	1	122
Har-Ed 22		
Pleistocene and Cretaceous sediments:		
Sand; clay, red	72	72
Clay, red	48	120
Gravel	34	154
Sand, coarse	42	196
Clay, sandy, hard	44	240
Clay, blue	20	260
Clay and wood	12	272
Clay, blue	13	285
Clay and gravel	20	305
Pre-Cambrian rocks:		
Rock	10	315
Har-Ed 23		
Pleistocene deposits and Patapsco formation:		
Sand and clay	10	10
Clay, blue	10	20
Clay, red	67	87
Sand, hard	2	89
Sand and gravel	21	110
Clay, red	5	115
Sand and gravel	5	120
Clay, gray	4	124

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Sand, white	7	131
Iron ore	2	133
Har-Ed 24		
Pleistocene deposits and Patapsco formation:		
Clay, yellow	15	15
Clay, gray	9	24
Clay, sandy, gray	9	33
Clay, brown	12	45
Clay, red	8	53
Clay, white	6	59
Clay, red	33	92
Clay, brown	3	95
Clay, gray	8	103
Sand, white, fine	14	117
Sand, white (water)	3	120
Sand, yellow (water)	15	135
Clay, red	14	149
Har-Ed 25		
Pleistocene deposits and Patapsco formation:		
Clay, yellow	11	11
Clay, light gray	22	33
Clay, gray	4	37
Clay, red; gravel	4	41
Clay, brown	8	49
Clay, gray	17	66
Clay, brown	29	95
Clay, gray	9	104
Sand and gravel (water)	7	111
Clay, white	13	124
Clay, yellow	1	125
Har-Ed 28		
Pleistocene and Cretaceous sediments:		
Sand, yellow	40	40
Sand, dark	13	53
Clay, sandy, red	7	60
Sandrock, hard	10	70
Clay, sandy, hard	25	95
Clay, soft; wood	15	110
Clay, blue	20	130
Clay, blue-white	20	150

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Clay, brown	31	181
Clay, red	49	230
Clay, red, white, and blue	110	340
Clay, blue and gray; solid granite rock at 402 feet	62	402
Pre-Cambrian rocks:		
How-Cf 1		
Patuxent formation:		
Topsoil and yellow clay	14	14
Clay, yellow; gravel	12	26
Soil, sandy, blue	2	28
Pre-Cambrian rocks:		
Clay, dark blue	6	34
Clay, light blue	11	45
Rock, blue, hard	45	90
Rock, gray, soft	30	120
Rock, blue, soft (small crevice at 165 feet)	45	165
Rock, gray, soft	30	195
Rock, black, soft	6	201
Bal-Ff		
Recent deposits:		
Soil, gray; cinders, "fill"	1	1
Pleistocene deposits:		
Clay, yellow	10	11
Cretaceous sediments:		
Clay, red	5.5	16.5
Sand, yellow (no water)	1.5	18
Clay, red	29.5	47.5
Iron ore, red; shale; gravel	1.5	49
Sand, yellow (water)	13	62
Clay, yellow	14	76
Clay, white	7	83
Clay, red	18	101
Clay, white, some yellow	2	103
Clay, sandy, white	3	106
Sand, white, fine and medium (water)	5	111
Clay, white	3	114
Clay, red	7	121
Clay, sandy, white	4	125
Sand, white, fine (water)	4	129
Sand, white; clay, red (water)	3	132

TABLE 16—*Continued*

	Thickness (feet)	Depth (feet)
Sand, white, coarse........................	14	146
Clay, white................................	6	152
Sand, white, medium........................	3	155
Bal-Gf		
Pleistocene deposits:		
Clay, blue; boulder........................	42	42
Sand, black (water)........................	2.5	44.5
Clay, blue.................................	55.5	100
Patapsco formation:		
Clay, red..................................	1.5	101.5
Sand, white, hard (water)..................	11.5	113

WATER LEVELS IN WELLS

Table 17 gives water-level measurements made periodically in selected observation wells. Most of the measurements were made with steel tapes graduated to 0.01 foot, automatic water-level recorders, and pressure gauges connected to an air line.

TABLE 17

Water Levels in Wells, Baltimore

4N2W-9. Baltimore Country Club. In Baltimore, at Falls Road at Harvest Road, 1.44 miles west and 3.55 miles north from Washington Monument. Unused drilled well, diameter 6 inches, depth 114 feet. Measuring point, arrow on top of brick curbing, 0.30 foot above land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1943		1944		1945	
Nov. 16	12.07	Sept. 15	13.13	May 11	11.03
30	12.72	22	13.34	18	11.08
Dec. 10	12.95	Oct. 12	13.55	25	11.36
31	13.23	19	13.55	June 1	11.12
1944		26	13.25	15	11.52
Jan. 15	11.99	Nov. 2	13.50	22	11.62
29	12.48	9	13.50	July 6	11.93
Feb. 19	12.22	16	13.60	13	12.24
Mar. 4	12.07	23	13.65	20	11.04
18	12.13	30	12.50	27	10.13
Apr. 8	10.50	Dec. 14	12.05	Aug. 3	8.59
29	10.04	22	12.67	10	9.62
May 13	10.32	29	12.77	17	9.98
20	10.41	1945		24	10.16
27	10.80	Jan. 4	12.07	31	10.12
June 3	11.01	11	12.63	Sept. 7	10.68
10	11.19	18	11.88	14	10.96
17	11.44	25	12.26	21	9.91
23	11.40	Feb. 1	12.54	Oct. 5	10.99
July 2	12.09	8	12.50	12	11.01
7	11.97	15	12.31	26	11.37
13	12.16	22	12.12	Nov. 2	11.45
21	12.29	Mar. 1	10.91	9	11.61
28	12.57	15	11.08	16	11.69
Aug. 4	12.57	22	11.30	23	11.07
11	12.73	30	11.45	30	10.63
18	12.98	Apr. 6	11.68	Dec. 7	9.82
25	13.18	20	11.65	17	11.29
Sept. 1	13.26	27	11.74	21	10.86
8	13.48	May 4	11.01	28	9.70

TABLE 17—*Continued*

1S3E-12. Kimball Tyler Co. In Baltimore, at Haven and Gough Streets, In Boiler House, 80 feet east of Haven Street. Unused drilled industrial well, diameter 6 inches, depth 183 feet. Measuring point, bottom edge of discharge pipe at land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1944		1944		1945	
Mar. 14	119.14	Oct. 26	121.94	June 1	116.40
25	113.60	Nov. 2	120.54	15	118.33
Apr. 7	113.66	9	120.55	22	118.73
15	114.54	16	119.97	July 6	119.40
22	113.60	30	119.84	13	112.93
29	114.90	Dec. 14	120.13	20	120.31
May 6	118.82	22	120.82	27	120.40
13	117.34	29	120.37	Aug. 3	120.27
20	119.03	1945		10	122.70
27	116.53	Jan. 4	120.37	17	118.89
June 3	120.65	11	119.94	24	120.00
10	115.69	18	119.76	31	119.67
17	115.13	25	118.74	Sept. 7	119.19
23	119.64	Feb. 1	119.34	14	118.87
July 7	118.78	8	116.57	21	118.98
13	120.07	15	119.94	28	118.24
21	120.06	22	120.13	Oct. 5	117.97
28	119.25	Mar. 1	118.15	16	118.60
Aug. 4	119.13	15	115.28	26	117.39
11	120.68	22	114.34	Nov. 2	117.30
18	118.94	30	114.13	9	117.80
25	120.33	Apr. 6	114.56	16	118.04
Sept. 1	117.80	13	113.51	23	120.86
8	117.99	20	113.98	30	117.64
15	120.47	27	113.46	Dec. 7	117.53
22	118.20	May 4	117.02	17	118.11
Oct. 5	119.07	11	118.49	21	118.05
12	121.84	18	117.84	28	117.50
19	122.97	24	112.11		

TABLE 17 — *Continued*

2S1E-16. Buck Glass Co. In Baltimore, at Lawrence Street and Fort Avenue, 100 feet south of Fort Avenue. Unused drilled industrial well, diameter 8 inches, depth 119 feet. Measuring point, top of pump base, 1.50 feet above land surface. Automatic water-stage recorder installed Apr. 5, 1943.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1943					
Mar. 28	57.62				

Daily highest and lowest water levels, in feet below land-surface datum
(From recorder charts)

Date	Depth to water		Date	Depth to water		Date	Depth to water	
	Low	High		Low	High		Low	High
1944			1944			1944		
Apr. 5	58.15	57.18	Apr. 29	54.61	54.53	May 31	54.97	54.23
6	58.19	57.47	30	54.58	48.35	June 1	55.31	54.79
7	57.49	57.20	May 1	53.37	48.35	2	55.35	55.16
8	57.54	56.50	2	54.00	51.87	3	55.21	42.80
14	52.22	51.59	3	54.01	53.13	4	46.90	41.15
15	52.64	52.22	4	53.19	52.96	5	53.23	41.15
16	53.16	52.50	5	53.32	53.13	6	54.00	53.23
17	53.40	51.55	13	46.30	41.04	7	54.75	53.84
18	54.17	51.50	15	52.10	41.09	8	54.83	54.58
19	54.12	53.93	16	53.01	52.10	9	54.70	54.44
20	54.01	53.73	17	53.40	52.75	10	54.77	42.48
21	54.08	53.78	18	53.78	53.19	11	46.55	41.01
22	54.15	53.97	19	53.80	53.33	23	54.36	53.66
23	54.22	43.33	20	54.51	42.25	24	53.66	41.77
24	51.94	43.33	21	47.33	40.60	25	47.31	40.79
25	54.51	51.94	27	45.68	43.14	30	52.98	52.78
26	54.79	54.48	28	43.14	42.00	July 1	53.35	42.22
27	54.59	54.31	29	54.17	42.00	2	53.36	42.21
28	54.75	54.53	30	54.37	54.17	3	43.76	40.94

TABLE 17 – *Continued*

2S1E-16. Buck Glass Co. – *Continued*

Date	Depth to water Low	Depth to water High	Date	Depth to water Low	Depth to water High	Date	Depth to water Low	Depth to water High
1944			1944			1944		
July 5	51.60	40.94	Aug. 18	52.70	52.41	Sept. 25	38.17	37.69
6	52.42	51.60	19	52.73	42.32	26	38.16	38.06
7	52.39	52.04	20	45.07	40.98	27	38.14	37.95
8	52.54	52.25	21	50.34	40.98	28	38.09	37.85
9	52.37	41.00	22	51.60	50.34	29	38.09	37.83
10	52.42	40.97	23	51.82	51.54	30	46.05	37.88
11	53.24	52.42	24	52.05	51.60	Oct. 5	50.45	50.33
12	53.23	51.86	25	52.20	51.95	6	50.75	50.38
13	52.94	52.32	26	52.15	41.74	7	50.79	50.60
14	52.95	52.79	27	41.80	40.95	8	50.65	40.22
15	52.90	42.00	28	50.69	41.06	12	51.05	50.86
16	47.11	40.96	29	51.63	50.67	13	51.05	50.85
17	51.35	40.96	30	51.84	51.54	14	51.10	50.75
21	51.53	51.42	31	51.95	43.85	15	51.27	41.15
22	51.63	41.90	Sept. 1	51.89	46.25	16	.....	40.24
23	44.22	40.97	2	52.04	51.72	19	50.11	50.03
24	50.50	40.97	3	51.99	43.05	20	50.20	49.07
25	51.58	50.50	4	43.05	40.96	21	49.58	49.07
26	51.94	51.57	5	50.45	40.96	22	49.72	40.08
27	51.87	51.14	6	51.47	50.45	23	48.52	39.60
28	53.17	51.24	7	51.80	51.35	24	49.12	48.52
29	53.17	41.32	8	52.00	51.70	25	49.93	48.93
30	42.69	40.95	9	52.13	51.80	26	50.34	49.81
31	51.91	40.95	10	52.04	41.95	27	50.61	48.85
Aug. 1	53.12	52.11	11	45.98	40.55	28	50.67	50.32
2	53.13	52.78	12	44.76	40.94	29	50.33	40.42
3	53.46	52.94	15	41.30	39.02	30	49.51	39.32
4	53.49	43.20	16	39.10	38.79	31	50.63	49.51
5	46.50	40.95	17	39.13	38.37	Nov. 1	50.81	50.60
7	51.65	40.95	18	38.43	37.98	2	50.91	50.65
8	52.58	51.65	19	38.54	38.36	3	50.89	50.61
9	52.95	52.00	20	38.57	38.32	4	50.73	50.50
10	53.18	52.18	21	38.35	38.10	5	50.69	40.60
11	51.92	51.76	22	42.05	38.11	6	50.39	40.00
12	51.76	41.58	23	38.75	38.56	7	50.68	44.98
13	45.00	41.15	24	38.60	37.82	8	50.49	50.02

TABLE 17 — *Continued*

2S1E-16. Buck Glass Co. — *Continued*

Date	Depth to water Low	High	Date	Depth to water Low	High	Date	Depth to water Low	High
1944			1944			1945		
Nov. 9	50.50	50.04	Dec. 20	49.65	48.85	Jan. 29	47.28	38.22
10	50.25	49.83	21	49.70	49.10	30	47.88	47.28
11	50.53	50.01	22	49.25	49.00	31	48.63	47.88
12	50.34	40.25	23	49.60	39.65	Feb. 1	48.73	48.57
13	49.82	39.52	24	39.65	38.59	2	48.66	48.46
14	50.15	43.76	29	49.34	49.04	3	48.60	40.15
15	49.22	39.51	30	49.19	47.67	4	42.62	38.33
16	50.20	49.22	31	48.29	39.30	5	41.42	38.15
17	50.50	50.00	1945			6	42.00	37.94
18	50.05	.....	Jan. 1	39.30	37.89	7	38.14	37.57
23	50.21	50.08	2	48.37	38.02	8	50.97	37.44
24	50.26	49.03	3	48.75	48.37	9	51.90	50.97
25	49.15	39.55	4	48.84	48.68	10	53.76	51.90
26	39.55	37.98	5	48.99	48.71	11	54.45	53.76
27	47.72	37.60	6	48.99	48.71	12	54.63	54.37
28	49.27	47.72	7	48.91	42.58	13	54.63	54.35
29	49.00	42.43	8	48.23	39.73	14	54.85	54.44
30	48.89	48.33	9	48.98	48.23	15	54.75	54.57
Dec. 1	49.96	48.89	10	49.28	48.98	22	49.51	49.33
2	50.02	40.07	11	49.28	48.99	23	49.90	49.50
3	42.87	38.54	12	49.32	48.76	24	50.25	49.90
4	48.50	38.42	13	49.08	39.77	25	50.31	40.31
5	48.68	48.26	14	39.77	38.33	26	48.60	39.55
6	48.40	48.17	15	47.80	38.22	27	49.82	48.60
7	48.32	48.14	16	48.44	47.76	28	49.98	49.73
8	48.70	47.73	17	48.20	47.82	Mar. 1	50.28	49.79
9	49.34	48.70	18	48.21	47.93	2	50.08	49.75
10	48.86	39.25	19	48.02	47.83	3	49.86	40.45
11	47.44	38.62	20	47.96	39.64	4	40.45	38.80
12	48.30	47.19	21	43.64	38.87	5	48.85	38.69
13	48.64	48.28	22	46.92	38.29	6	49.28	48.85
14	49.45	44.42	23	47.57	36.92	7	49.88	49.28
15	48.78	42.13	24	48.19	47.50	9	49.75	49.52
16	48.77	48.67	25	48.47	48.06	10	49.75	40.45
17	49.00	39.29	26	48.23	47.98	11	40.45	38.87
18	48.19	39.00	27	48.22	39.65	12	48.37	38.50
19	49.55	48.19	28	39.65	38.34	13	49.21	48.37

TABLE 17 – *Continued*

2S1E-16. Buck Glass Co. – *Continued*

Date	Depth to water Low	Depth to water High	Date	Depth to water Low	Depth to water High	Date	Depth to water Low	Depth to water High
1945			1945			1945		
Mar. 14	49.52	49.21	Apr. 23	47.32	38.34	May 30	38.39	37.82
15	49.57	49.27	24	47.78	47.32	31	37.95	37.35
16	49.54	49.27	25	47.95	47.65	June 1	38.15	37.47
17	49.54	40.05	26	48.28	47.90	2	39.85	37.79
18	42.55	38.84	27	48.75	48.18	3	44.51	37.70
19	47.97	38.52	28	48.80	39.80	4	41.50	37.63
20	48.56	47.97	29	39.80	38.35	5	51.45	38.51
21	48.46	39.88	30	48.38	38.23	6	53.22	51.45
22	48.56	47.74	May 1	48.50	48.38	7	53.54	53.15
23	48.66	48.05	2	49.53	48.50	8	54.00	53.32
24	48.22	39.38	3	48.60	48.13	9	54.37	53.79
25	43.42	38.74	4	49.43	48.35	10	53.85	41.15
26	48.25	38.35	5	49.56	39.90	11	52.78	39.50
27	49.02	48.25	6	43.52	38.90	12	54.13	52.78
28	49.29	49.02	7	47.81	38.43	13	54.42	53.85
29	49.36	49.09	8	48.37	47.81	15	55.00	54.22
30	49.50	49.15	9	48.33	43.18	16	55.66	41.30
31	49.43	40.41	10	43.24	42.48	17	47.36	39.48
Apr. 1	40.41	38.52	11	43.16	42.49	18	54.92	38.97
2	48.27	38.42	12	42.96	38.83	19	55.87	54.92
3	49.27	48.27	13	38.83	37.95	20	55.87	55.63
4	49.27	48.86	14	41.99	37.98	21	55.87	55.77
5	49.56	48.81	15	42.08	41.85	22	56.28	55.81
6	49.86	49.56	16	42.21	41.89	23	56.30	41.75
7	49.60	40.83	17	50.30	41.73	24	41.75	39.43
8	40.83	38.58	18	52.44	50.30	25	54.00	39.05
9	46.18	38.39	19	52.82	40.57	26	55.16	54.00
10	47.28	46.18	20	40.57	38.50	27	55.30	55.10
11	47.37	47.13	21	51.45	37.99	28	55.25	55.13
12	48.05	47.16	22	52.44	51.45	29	55.42	55.03
13	48.69	48.05	23	53.59	52.44	July 3	43.67	40.81
14	48.72	40.85	24	53.70	42.31	4	40.81	39.20
15	40.85	38.60	25	53.84	53.18	5	39.20	38.50
16	46.00	38.43	26	53.87	41.20	6	38.51	38.27
20	49.88	49.47	27	41.20	38.67	7	38.50	38.19
21	49.90	39.91	28	38.67	38.28	8	38.35	38.01
22	39.91	38.72	29	38.34	38.15	9	46.60	37.64

TABLE 17 – *Continued*

2S1E-16. Buck Glass Co. – *Continued*

Date	Depth to water Low	Depth to water High	Date	Depth to water Low	Depth to water High	Date	Depth to water Low	Depth to water High
1945			1945			1945		
July 10	49.80	46.60	Aug. 25	56.02	44.17	Oct. 5	53.70	53.29
13	54.83	54.68	27	54.36	44.17	6	53.46	53.30
14	55.15	41.99	28	55.03	54.36	7	53.49	49.65
15	53.48	39.91	29	55.55	55.03	8	52.65	49.65
16	54.07	39.69	30	55.83	55.39	9	53.11	49.64
17	54.62	54.07	31	55.80	55.57	10	53.50	53.06
18	54.97	54.20	Sept. 1	55.73	55.48	11	53.50	53.18
19	54.46	54.17	2	55.52	41.68	12	53.27	53.15
20	54.42	54.24	3	41.68	39.52	13	53.85	53.23
21	54.38	40.78	4	54.32	39.15	14	53.60	44.17
22	40.78	38.91	5	55.15	54.32	15	50.80	44.17
23	54.31	38.55	6	55.54	55.15	19	53.40	53.15
24	54.90	53.57	7	55.63	55.46	20	53.55	53.23
25	55.32	54.90	8	55.63	55.44	21	53.55	40.57
26	55.59	55.21	9	55.71	40.72	22	44.68	39.79
27	55.64	55.42	10	50.83	40.17	26	38.43	38.20
28	55.72	55.45	14	55.03	54.81	27	38.55	38.17
29	55.57	41.75	15	55.13	41.80	28	38.25	37.96
30	53.40	40.73	16	49.67	40.69	29	38.01	37.75
31	53.95	53.33	17	52.67	44.18	30	52.49	37.62
Aug. 1	54.01	53.52	18	52.87	52.36	31	52.32	51.63
2	55.72	53.64	19	53.42	52.79	Nov. 1	51.93	51.61
10	56.57	54.54	20	53.52	53.19	2	52.82	51.41
11	56.66	42.23	21	53.63	53.32	3	53.38	52.82
12	49.21	40.47	22	53.85	39.82	4	53.52	40.32
13	55.22	40.24	23	47.97	38.27	5	53.15	39.64
14	55.82	39.58	24	53.00	39.20	6	53.89	53.15
16	54.54	39.58	25	53.22	52.88	7	54.03	53.85
17	55.33	54.54	26	53.37	52.90	8	54.17	53.95
18	55.67	54.98	27	53.50	53.24	9	54.24	54.05
19	55.66	41.34	28	54.20	53.98	10	54.68	54.12
20	55.26	40.19	29	54.03	50.40	11	54.73	41.20
21	55.75	55.23	Oct. 1	52.14	49.65	12	51.75	40.15
22	56.07	55.67	2	53.34	52.08	13	52.17	51.75
23	56.25	55.93	3	53.75	53.25	14	52.93	51.15
24	56.25	55.81	4	53.75	53.54	15	53.28	52.93

TABLE 17 – *Continued*

2S1E-16. Buck Glass Co. – *Continued*

Date	Depth to water Low	High	Date	Depth to water Low	High	Date	Depth to water Low	High
1945			1945			1945		
Nov. 16	53.03	52.52	Dec. 1	53.33	53.10	Dec. 18	51.70	44.34
17	52.55	52.19	2	53.22	39.65	19	51.86	51.50
18	52.39	40.05	3	51.65	38.92	20	51.89	51.52
19	50.67	39.46	4	52.64	51.65	21	51.66	41.00
20	49.93	49.20	5	52.81	52.48	22	41.00	38.98
21	49.98	49.42	6	52.77	52.59	23	39.16	38.68
22	49.64	49.30	7	52.94	52.64	24	38.68	38.16
23	49.87	49.64	8	53.01	52.68	25	38.16	37.27
24	50.12	49.72	9	53.98	40.05	26	49.41	37.22
25	49.82	39.88	10	50.60	39.04	27	50.50	49.41
26	52.13	38.82	11	52.60	50.60	28	50.61	50.50
27	52.53	52.13	12	53.05	52.58	29	50.57	50.44
28	52.63	52.34	13	53.20	52.79	30	51.60	50.16
29	52.82	52.45	14	52.88	52.70	31	50.33	39.75
30	53.26	52.82	17	51.55	50.42			

2S3E-9. J. S. Young Co. In Baltimore, at Boston and Luzerne Streets, outside shed 6, 1.37 miles south and 1.94 miles east from Washington Monument. Unused drilled industrial well, depth 137 feet. Measuring point, top of dicharge pipe, 2.50 feet above land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1943		1943		1943	
June 2	37.09	July 31	37.75	Dec. 10	37.61
7	35.89	Aug. 6	37.83	1944	
15	36.22	13	37.84	Jan. 15	37.06
22	36.14	19	38.65	22	36.82
28	35.72	Sept. 1	37.80	29	36.48
July 6	35.80	9	37.45	Feb. 19	37.06
13	36.27	Oct. 8	37.74	Mar. 4	36.70
21	36.85	Nov. 5	35.71	11	37.10

TABLE 17 – *Continued*

2S3E-9. J. S. Young Co.–*Continued*

Date	Depth to water	Date	Depth to water	Date	Depth to water
1944		1944		1944	
Mar. 18	35.91	May 6	36.27	June 10	37.20
Apr. 8	32.45	13	36.20	17	36.98
22	35.97	20	37.32		
29	36.08	27	37.45		

2S3E-11. J. S. Young Co. In Baltimore, at Boston and Luzerne Streets, outside machine shop, 100 feet southwest of well 2S3E-9. Unused drilled industrial well, diameter 8 inches, depth 160 feet. Measuring point, top of casing, 1.50 feet above land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1943		1944		1944	
June 2	34.21	Jan. 29	35.08	July 28	35.05
7	34.75	Feb. 19	36.27	Aug. 4	35.67
15	34.90	Mar. 4	35.21	11	34.61
22	34.92	11	35.88	18	35.49
28	34.81	18	34.87	25	35.60
July 6	34.61	Apr. 8	34.72	Sept. 1	34.41
13	34.47	22	34.40	8	34.15
21	35.04	29	34.45	15	33.60
31	35.96	May 6	34.32	22	33.29
Aug. 6	36.16	13	35.87	Oct. 5	34.81
13	35.55	20	35.08	12	33.94
19	36.54	27	35.68	19	34.31
Sept. 2	35.99	June 3	37.44	26	34.30
9	35.58	10	35.62	Nov. 2	34.26
Oct. 8	36.12	17	35.17	9	33.52
Nov. 5	35.13	23	35.41	23	32.94
Dec. 10	35.58	30	34.90	30	33.07
1944		July 7	34.22	Dec. 14	33.45
Jan. 15	35.60	14	34.83	22	33.96
22	35.27	21	34.72	29	33.67

TABLE 17 – *Continued*

2S3E-11. J. S. Young Co. – *Continued*

Date	Depth to water	Date	Depth to water	Date	Depth to water
1945		1945		1945	
Jan. 11	33.51	May 11	32.64	Sept. 14	32.93
18	33.52	18	32.23	21	32.64
25	33.62	25	32.70	28	32.58
Feb. 1	33.77	June 1	32.42	Oct. 5	32.85
8	33.06	15	33.52	16	31.87
15	33.02	22	33.78	26	31.82
22	33.34	July 6	33.18	Nov. 2	31.72
Mar. 1	33.52	13	33.06	9	32.18
15	33.12	20	33.69	16	32.49
22	32.61	27	32.90	23	32.22
30	32.84	Aug. 3	33.43	30	32.16
Apr. 6	33.09	10	33.84	Dec. 7	31.93
13	33.17	17	32.99	17	32.70
20	32.64	25	33.25	21	32.62
27	32.34	31	33.16	28	31.60
May 4	32.34	Sept. 7	32.96		

2S5E-1. U. S. Army's well 106. In Baltimore, on Holabird Avenue at Pumphrey Street, 1.81 miles south and 4.13 miles east from Washington Monument. Unused drilled well, diameter 12 inches, depth 290 feet. Measuring point, end of discharge pipe, 2.00 feet above land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1943		1943		1944	
Apr. 2	81.00	July 31	89.80	Jan. 8	90.67
May 15	83.55	Aug. 6	88.05	15	92.67
28	84.99	11	90.06	22	90.79
June 15	82.24	18	89.08	29	90.31
22	80.89	25	91.50	Feb. 5	89.75
28	83.27	Sept. 1	89.59	19	91.80
July 6	82.48	9	90.70	26	90.59
13	84.58	Oct. 8	90.54	Mar. 4	91.17
21	87.88	Nov. 5	89.14	11	90.77

TABLE 17—*Continued*

2S5E-1. U. S. Army's well 106—*Continued*

Date	Depth to water	Date	Depth to water	Date	Depth to water
1944		1944		1945	
Mar. 18	89.72	Nov. 24	90.74	July 13	90.91
Apr. 8	90.90	30	90.41	20	90.11
22	89.75	Dec. 14	90.43	27	86.52
29	90.28	29	88.72	Aug. 3	88.08
May 6	91.65	1945		10	86.34
13	93.25	Jan. 4	87.12	17	85.15
20	92.79	11	89.29	24	86.22
27	90.70	Feb. 8	85.31	31	87.03
June 3	90.94	15	84.54	Sept. 9	85.68
July 14	90.20	22	86.90	21	82.68
21	90.39	Mar. 1	87.02	28	82.79
28	90.55	15	85.37	Oct. 5	81.37
Aug. 4	91.47	22	86.00	18	86.81
11	91.82	30	86.53	26	85.50
18	92.58	Apr. 6	84.50	Nov. 2	85.86
Sept. 1	91.71	20	83.12	9	84.34
8	91.18	27	84.49	16	86.28
15	91.20	May 4	86.50	23	85.52
22	91.29	12	86.30	30	85.83
Oct. 5	91.65	18	89.91	Dec. 7	85.26
26	90.51	25	88.59	17	85.18
Nov. 2	91.73	June 1	90.02	21	85.93
9	90.92	22	91.37	28	84.65
16	91.62	July 6	91.37		

TABLE 17 — *Continued*

2S5E-4. U. S. Army. In Baltimore, on Holabird Avenue at Pumphrey Street, 20 feet east of well 2S5E-1. Unused drilled well, diameter 6 inches, depth 192 feet. Measuring point, top of casing, 3.60 feet above land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1943		1944		1945	
May 15	77.79	May 13	83.70	Apr. 6	83.97
28	77.95	20	83.82	20	83.76
June 7	78.06	27	83.95	27	83.67
15	78.15	June 3	84.04	May 4	83.65
22	78.18	July 14	84.33	12	83.68
28	78.19	21	84.39	18	83.71
July 6	78.28	28	84.44	25	83.74
13	78.42	Aug. 4	84.47	June 1	83.81
21	78.55	11	84.55	22	84.09
31	78.83	18	84.66	July 6	84.30
Aug. 6	78.98	Sept. 1	84.81	13	84.42
11	79.10	8	84.86	20	84.42
18	79.30	15	84.94	27	84.50
25	79.50	22	85.07	Aug. 3	84.51
Sept. 1	79.67	Oct. 5	85.12	10	84.47
9	79.90	26	85.28	17	84.51
Oct. 8	79.53	Nov. 2	85.34	24	84.30
Nov. 5	78.95	9	85.39	31	84.51
1944		16	85.48	Sept. 7	84.49
Jan. 8	92.00	24	85.43	21	84.39
15	83.41	30	85.60	28	84.20
22	82.26	Dec. 14	85.69	Oct. 5	81.29
29	82.38	29	85.81	18	81.08
Feb. 5	83.46	1945		26	83.90
19	82.68	Jan. 4	85.77	Nov. 2	81.19
26	82.80	11	85.78	9	81.23
Mar. 4	82.90	Feb. 8	85.84	16	81.26
11	83.00	15	84.12	23	81.32
18	83.10	22	83.97	30	81.37
Apr. 8	83.37	Mar. 1	84.01	Dec. 7	81.38
22	84.43	15	84.02	17	81.43
29	84.45	22	83.99	21	81.46
May 6	83.57	30	83.98	28	81.48

TABLE 17 – *Continued*

3S5E-3. Federal Yeast Co.'s well, Air Lift 1. In Baltimore, 2.25 miles south and 4.09 miles east from Washington Monument. Unused drilled industrial well, diameter 6 inches, depth 131.3 feet. Measuring point, top of casing, 0.50 foot above land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1915		1944		1945	
-----	[b]15	May 27	44.93	Apr. 27	51.13
1943		June 10	45.09	May 4	50.59
May 10	40.40	17	45.05	11	50.72
31	41.73	Sept. 15	44.67	18	50.74
June 1	41.60	22	44.68	25	46.55
7	41.80	Oct. 5	44.75	June 1	44.83
15	41.94	12	44.70	15	43.60
22	41.99	19	44.70	22	44.36
28	41.94	26	44.45	July 6	41.21
July 6	42.02	Nov. 2	44.39	13	44.24
12	42.10	9	44.37	20	43.66
19	42.32	16	44.21	27	43.27
31	42.86	23	44.16	Aug. 3	43.22
Aug. 25	43.90	30	43.96	10	45.72
Sept. 1	44.10	Dec. 14	43.91	17	47.16
9	44.24	22	43.96	24	47.46
Oct. 8	44.66	29	43.65	31	48.28
Nov. 5	44.46	1945		Sept. 7	47.07
Dec. 10	44.86	Jan. 4	43.77	14	48.36
1944		11	43.72	21	47.04
Jan. 15	44.80	18	43.58	28	46.79
22	45.39	25	45.25	Oct. 5	47.36
29	45.51	Feb. 1	47.10	17	41.98
Feb. 5	45.57	8	48.32	26	41.52
26	45.52	15	49.14	Nov. 2	41.24
Mar. 4	45.63	22	48.23	9	41.10
11	45.48	Mar. 1	49.44	16	41.02
18	45.29	9	49.54	23	40.99
Apr. 8	45.13	15	50.08	30	40.87
22	45.00	22	49.75	Dec. 7	40.63
29	45.05	30	50.25	17	40.68
May 6	45.36	Apr. 6	50.81	21	40.75
13	44.88	13	51.15	28	41.05
20	45.11	20	51.22		

[b]*Water level reported.*

TABLE 17 – *Continued*

3S5E-4. Federal Yeast Co.'s well, Air Lift 2. In Baltimore, 2.25 miles south and 4.09 miles east from Washington Monument. Unused drilled industrial well, diameter 6 inches, depth 130 feet. Measuring point, top of casing, 1.00 foot above land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1943		1943		1944	
May 10	41.63	July 26	43.41	Mar. 4	45.15
17	41.83	31	43.89	11	45.27
21	42.30	Aug. 6	44.11	18	44.54
28	42.30	11	44.20	Apr. 8	45.01
31	42.22	Sept. 9	44.39	22	44.72
June 7	42.06	Dec. 10	45.54	29	44.62
15	42.13	1944		May 6	44.83
22	40.90	Jan. 15	45.55	13	45.02
28	41.74	22	45.60	20	44.87
July 5	41.13	29	45.27	27	45.16
12	42.02	Feb. 5	45.15	June 10	44.88
19	43.13	26	45.00	17	44.76

3S5E-6. Federal Yeast Co.'s well, Air Lift 4. In Baltimore, 2.25 miles south and 4.09 miles east from Washington Monument. Unused drilled industrial well, diameter 6 inches, depth 130 feet. Measuring point, top of casing, 0.30 foot above land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1943		1943		1943	
May 10	41.33	June 28	41.46	Oct. 8	44.37
17	41.58	July 5	40.91	Nov. 5	43.91
21	41.91	12	41.78	Dec. 10	45.24
28	42.07	19	42.84	1944	
31	42.00	31	43.62	Jan. 8	45.13
June 7	41.95	Aug. 4	43.78	22	45.34
15	42.04	11	43.97	29	45.02
22	43.66	Sept. 9	44.05	Feb. 5	44.83

TABLE 17 – *Continued*

3S5E-6. Federal Yeast Co.'s well, Air Lift 4 – *Continued*

Date	Depth to water	Date	Depth to water	Date	Depth to water
1944		1944		1944	
Feb. 26	45.20	June 30	44.45	Nov. 16	44.56
Mar. 4	44.94	July 7	43.87	23	43.16
11	45.29	14	44.15	30	43.61
18	44.27	21	44.04	Dec. 14	43.78
Apr. 8	44.70	28	44.02	29	43.40
22	44.50	Sept. 8	44.36	1945	
29	44.35	15	44.18	Jan. 4	43.64
May 13	44.72	22	44.42	11	43.56
20	45.01	Oct. 5	44.05	18	43.61
27	44.90	12	44.14	25	49.37
June 3	44.50	19	43.94	Feb. 1	[a]56.98
10	44.50	26	43.06	8	[a]55.61
17	44.48	Nov. 2	43.86	15	[a]56.18
23	44.22	9	43.48	Oct. 17	40.89

[a]*Well pumping at time of measurement.*

3S5E-7. Federal Yeast Co.'s well, Air Lift 5. In Baltimore, 2.25 miles south and 4.09 miles east from Washington Monument. Unused drilled industrial well, diameter 8½ inches, depth 130 feet. Measuring point, top of casing, 2.30 feet above land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1943		1943		1943	
May 10	39.38	July 12	39.74	Sept. 9	42.00
31	39.95	19	40.78	Oct. 8	42.27
June 22	38.55	31	41.69	Nov. 5	41.91
28	39.40	Aug. 6	42.33	Dec. 10	43.19
July 5	38.80	11	41.86	1945	
				Oct. 17	38.86

TABLE 17 – *Continued*

3S5E-8. Federal Yeast Co.'s well, Air Lift 6. In Baltimore, 2.25 miles south and 4.09 miles east from Washington Monument. Unused drilled industrial well, diameter 8 inches, depth 309 feet. Measuring point, top of casing, 2.50 feet above land surface. Automatic water-stage recorder installed Aug. 16, 1943.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1921		1943		1943	
--------	[b]24	May 28	59.08	July 12	79.11
1943		31	77.14	19	83.17
May 10	74.49	June 7	77.02	31	82.89
17	76.59	15	71.03	Aug. 6	83.67
21	75.50	22	72.19	11	84.13
		28	78.14		
		July 5	69.53		

[b]*Water level reported*

Daily highest and lowest water levels, in feet below land-surface datum
(From recorder charts)

Date	Depth to water		Date	Depth to water		Date	Depth to water	
	Low	High		Low	High		Low	High
1943			1943			1943		
Aug. 16	85.36	83.61	Aug. 31	85.80	84.10	Sept. 13	84.62	79.38
17	85.09	80.30	Sept. 1	84.80	81.20	14	85.58	82.92
18	84.60	80.30	2	85.75	81.20	15	85.64	82.25
19	82.20	79.95	3	86.78	85.00	16	86.82	81.15
20	84.30	79.95	4	85.99	81.92	17	88.10	83.80
21	84.30	81.28	5	82.10	79.40	18	86.60	83.74
22	81.15	78.90	6	80.60	79.00	19	87.70	85.30
23	83.60	78.90	7	85.95	80.15	20	88.12	83.80
24	83.60	81.80	8	87.95	84.87	21	83.17	81.20
25	85.60	82.30	9	89.20	84.30	22	84.87	81.02
26	85.45	81.35	10	84.98	83.90	23	87.25	83.42
29	80.70	78.90	11	85.24	81.78	24	87.00	84.02
30	84.37	78.90	12	81.75	79.38	25	86.39	80.85

TABLE 17—*Continued*

3S5E-8. Federal Yeast Co.'s well, Air Lift 6—*Continued*

Date	Depth to water Low	Depth to water High	Date	Depth to water Low	Depth to water High	Date	Depth to water Low	Depth to water High
1943			1943			1944		
Sept. 26	81.05	79.40	Nov. 4	84.17	80.30	Jan. 15	86.07	82.30
27	83.98	79.34	5	83.46	80.12	16	85.83	82.17
28	84.67	82.15	6	84.20	81.80	17	87.04	82.18
29	83.97	81.50	7	85.50	83.68	18	88.01	84.62
30	86.05	80.74	8	85.69	79.21	19	88.10	84.01
Oct. 1	86.90	84.27	9	81.76	79.00	20	87.62	83.62
2	86.40	80.35	10	81.12	79.40	21	88.31	85.39
3	80.35	78.80	11	83.28	78.95	22	87.90	82.50
4	83.73	78.58	12	83.95	81.55	23	82.50	81.00
5	84.35	82.55	13	83.50	81.50	24	85.30	81.36
6	84.65	81.50	14	83.50	82.07	25	86.55	83.70
7	86.42	81.05	19	85.00	82.54	26	86.25	82.40
8	87.03	84.42	25	80.42	79.50	28	85.98	82.60
9	86.73	81.80	26	83.50	79.70	29	86.97	81.83
10	81.80	80.10	27	84.08	81.58	30	82.94	81.50
11	86.20	79.75	28	85.57	84.08	31	84.50	81.11
12	87.10	84.90	29	85.82	81.73	Feb. 1	85.01	81.56
13	86.11	82.47	30	84.78	82.02	2	84.48	81.40
14	86.23	82.25	Dec. 1	84.75	80.93	3	85.93	82.80
15	86.75	85.05	2	81.10	79.34	4	85.38	81.41
16	85.00	82.05	9	89.90	85.50	5	85.87	82.13
18	84.10	82.00	10	90.84	87.74	6	83.07	87.53
19	84.74	82.70	11	89.54	86.15	7	84.96	80.58
20	85.40	82.05	12	86.16	84.67	8	88.00	84.80
21	85.70	82.05	13	87.48	84.12	9	86.54	82.73
22	86.00	83.25	14	88.28	85.85	10	86.70	82.15
23	85.75	82.10	15	87.37	84.44	11	87.50	84.80
25	82.00	79.37	16	87.20	85.00	12	85.88	84.52
26	80.90	78.50	1944			14	85.05	82.86
27	82.51	78.85	Jan. 7	82.92	81.35	15	84.79	82.47
28	85.58	80.61	8	84.44	82.70	16	86.31	82.47
29	85.20	82.65	9	83.15	81.85	17	87.77	83.00
30	85.68	79.85	10	85.25	81.20	18	.....	82.53
31	79.85	77.63	11	85.55	82.20	19	.....	82.65
Nov. 1	82.60	78.35	12	85.80	82.25	20	82.73	81.30
2	83.05	79.80	13	86.04	82.72	21	85.13	80.94
3	83.44	79.72	14	85.70	82.22	22	86.66	82.93

TABLE 17—*Continued*

3S5E-8. Federal Yeast Co.'s well, Air Lift 6—*Continued*

Date	Depth to water Low	Depth to water High	Date	Depth to water Low	Depth to water High	Date	Depth to water Low	Depth to water High
1944			1944			1944		
Feb. 23	85.72	81.77	Apr. 23	81.86	80.40	July 2	88.41	85.32
24	87.57	83.00	24	86.83	80.40	3	88.30	83.67
25	87.91	82.69	25	87.30	82.53	4	89.15	83.92
26	89.25	82.63	26	86.15	81.50	5	88.23	82.88
27	82.72	81.50	27	88.04	85.82	6	89.96	87.87
28	84.81	80.97	28	88.96	85.54	7	91.22	88.77
29	85.93	83.12	29	88.15	82.35	8	91.42	88.15
Mar. 1	86.96	83.47	30	82.44	81.31	9	88.15	85.01
2	87.81	84.68	May 1	85.37	80.43	10	88.93	84.76
3	87.63	84.79	2	88.60	85.33	11	90.67	88.93
4	87.53	84.95	3	86.45	82.70	12	91.37	90.67
5	84.95	82.68	4	88.60	85.25	13	91.65	91.34
11	84.00	82.55	5	90.91	83.83	14	92.25	91.63
12	82.55	80.25	6	90.07	84.58	15	92.25	91.61
13	84.82	79.57	7	84.58	83.09	16	91.61	90.85
18	83.85	81.75	8	86.35	82.56	17	91.47	90.46
19	81.75	80.55	13	90.32	88.00	18	91.91	91.10
20	84.75	81.12	14	88.00	83.85	19	91.95	91.71
21	87.42	84.75	15	90.22	87.57	20	92.00	91.57
Apr. 1	87.72	86.45	16	89.35	85.13	21	92.00	87.48
2	86.45	82.00	17	89.51	86.68	22	87.48	86.00
3	87.60	81.96	20	86.68	85.15	23	86.00	82.73
4	88.08	85.44	21	85.22	84.10	24	89.63	82.83
5	86.58	82.65	27	83.57	81.32	25	91.84	89.63
6	88.00	84.60	28	82.95	79.28	26	91.94	89.71
7	89.21	87.30	June 2	90.21	88.00	27	92.28	91.84
8	87.91	83.83	3	89.64	85.31	28	92.38	92.20
9	83.20	82.38	17	89.85	84.74	29	92.39	87.72
15	82.42	81.62	18	85.25	82.28	30	87.72	86.50
16	81.69	80.25	19	87.75	82.49	31	91.08	85.82
17	84.41	78.68	20	88.48	82.60	Aug. 1	92.02	91.08
18	86.66	83.70	21	87.15	82.24	2	92.08	91.65
19	86.35	81.64	22	89.12	86.85	3	92.45	91.59
20	87.07	83.77	23	89.26	86.86	4	93.85	92.45
21	85.38	81.49	30	90.60	88.28	5	94.17	93.85
22	87.07	81.70	July 1	88.28	86.60	6	94.23	92.16
						7	92.36	91.99

TABLE 17—*Continued*

3S5E-8. Federal Yeast Co.'s well, Air Lift 6—*Continued*

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1945					
Oct. 17	86.68				

3S5E-9. Federal Yeast Co.'s well, Air Lift 7. In Baltimore, 2.25 miles south and 4.09 miles east from Washington Monument. Unused drilled industrial well, diameter 6 inches, depth 130.5 feet. Measuring point, top of air line, 3.00 feet above land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1943		1943		1944	
May 10	41.29	Aug. 6	43.67	Mar. 11	44.78
17	40.54	11	43.80	18	44.17
21	41.74	Sept. 9	43.97	Apr. 8	44.60
28	41.93	Oct. 8	44.23	22	44.32
31	41.94	Nov. 5	43.85	29	44.30
June 7	41.71	Dec. 10	45.05	May 6	44.17
15	41.52	1944		13	44.60
22	40.60	Jan. 15	45.14	20	44.38
28	41.35	22	45.00	27	42.68
July 5	40.82	29	44.82	June 10	44.46
12	41.70	Feb. 5	44.77	17	44.37
19	42.71	26	45.00	23	44.09
31	43.49	Mar. 4	44.55	30	43.10
				July 28	39.54

TABLE 17—*Continued*

4S2E-4. Weyerhaeuser Lumber Co. In Baltimore, 30 feet east of Childs Street and 800 feet southwest of docks. Unused drilled industrial well, diameter 6 inches, depth 290 feet. Measuring point, top of casing, 2 feet above land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1939		1945		1945	
--------	[b]41	July 27	61.45	Oct. 15	56.78
1940		Aug. 3	63.24	26	56.31
Sept.	[b]81	10	64.11	Nov. 2	55.84
1945		17	59.21	9	56.49
May 22	57.75	24	61.72	16	56.06
June 1	65.35	31	60.42	23	56.22
15	60.40	Sept. 7	60.25	30	57.35
22	65.11	14	59.59	Dec. 7	57.22
July 6	62.17	21	59.14	17	58.98
13	64.06	28	58.66	21	59.68
20	61.33	Oct. 5	57.11	28	58.31

5S3E-15. U. S. Industrial Chemical Co.'s well 1701. In Baltimore, on vacant lot 50 feet north of Patapsco Ave. and 800 feet west of Fairfield Road. Unused drilled industrial well, diameter 6 to 3 inches, depth 200± feet. Measuring point, top of casing, at land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1916		1945		1945	
--------	[b]47	May 18	96.92	Sept. 14	104.68
1945		25	93.65	21	103.70
Jan. 26	105.87	June 1	95.16	28	103.60
Feb. 1	103.93	15	93.70	Oct. 5	101.11
8	102.27	22	98.88	15	99.94
15	103.55	July 6	98.54	26	100.60
22	103.49	13	94.69	Nov. 2	99.82
Mar. 1	103.36	20	93.79	9	100.37
15	102.34	27	102.78	16	104.99
22	102.57	Aug. 3	103.92	23	103.61
Apr. 6	99.42	10	103.84	30	112.02
20	97.90	17	103.67	Dec. 7	109.82
27	97.42	24	104.16	17	121.05
May 4	99.90	31	104.11	21	125.50
11	99.96	Sept. 7	104.76	28	114.54

[b]*Water level reported.*

TABLE 17 – *Continued*

5S3E-16. U. S. Industrial Chemical Co.'s well 1702. In Baltimore, on vacant lot 150 feet north of Patapsco Ave. and 800 feet west of Fairfield Road. Unused drilled industrial well, diameter 8 inches, depth 347 feet. Measuring point, top of casing, at land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1916		1945		1945	
--------	[b]37	May 11	102.54	Sept. 14	103.14
1945		25	96.12	21	101.98
Jan. 26	106.73	June 1	102.17	28	101.78
Feb. 1	105.56	15	99.21	Oct. 5	100.42
8	103.98	22	103.09	15	98.87
15	103.21	July 6	101.65	26	99.05
22	105.45	13	99.55	Nov. 2	98.33
Mar. 1	95.55	20	93.25	9	105.51
15	104.11	27	88.55	16	98.35
22	104.18	Aug. 3	103.55	23	96.22
Apr. 6	105.60	10	104.97	30	100.18
13	103.37	17	104.38	Dec. 7	94.88
20	101.41	24	101.98	17	100.46
27	101.29	31	103.32	21	101.55
May 4	102.93	Sept. 7	102.74	28	95.71

[b]*Water level reported*

6S2E-1. U. S. Industrial Chemical Co.'s well 4241. In Baltimore, at Birch and Curtis Streets, 5.50 miles south and 1.62 miles east from Washington Monument. Used drilled industrial well, diameter 10 inches, depth 245 feet. Measuring point, top of air line, 3.00 feet above land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1943		1943		1943	
July 6	[a]121	July 31	[a]121	Aug. 19	[a]121
14	[a]122	Aug. 6	[a]121	26	[a]120
21	[a]119	13	[a]118	Sept. 2	[a]119

TABLE 17 — *Continued*

6S2E-1. U. S. Industrial Chemical Co.'s well 4241 — *Continued*

Date	Depth to water	Date	Depth to water	Date	Depth to water
1943		1944		1945	
Sept. 10	[a]121	July 7	[a]104	Jan. 18	[a]114
Oct. 8	[a]121	14	[a]104	25	[a]114
Nov. 5	[a]118	21	[a]102	Feb. 1	[a]110
Dec. 10	[a]118	28	[a]104	8	[a]110
1944		Aug. 4	[a]110	15	[a]111
Jan. 15	[a]113	11	[a]108	22	[a]111
22	[a]111	18	[a]109	Mar. 1	[a]112
29	[a]112	25	[a]109	15	[a]110
Feb. 19	[a]112	Sept. 1	[a]109	22	[a]112
Mar. 4	[a]110	15	[a]114	Apr. 6	[a]111
11	[a]111	Oct. 5	[a]98	20	[a]99
18	[a]110	19	[a]111	27	[a]104
Apr. 8	[a]107	26	[a]110	May 4	[a]107
22	[a]109	Nov. 2	[a]112	11	[a]109
29	[a]109	9	[a]111	18	[a]109
May 13	[a]109	16	[a]106	25	[a]108
20	[a]109	23	[a]112	June 1	[a]109
27	[a]107	30	[a]112	15	[a]107
June 3	[a]109	Dec. 22	[a]113	22	[a]110
10	[a]109	29	[a]110	July 6	[a]109
17	[a]109	1945		Aug. 3	81
23	[a]109	Jan. 4	[a]110	15	[a]106
July 3	[a]107	11	[a]113	31	[a]107
				Nov. 16	[a]96

[a]*Well pumping at time of measurement.*

6S2E-4. U. S. Industrial Chemical Co.'s well 3700. In Baltimore, 100 feet east of well 6S2E-1, in the same well field. Used drilled industrial well, diameter 10 inches, depth 227 feet. Measuring point, top of air line, 2.80 feet above land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1939		1943		1943	
--------	[a]76	July 14	[a]171	Aug. 26	[a]172
--------	[a,b]177	21	[a]169	Sept. 2	[a]170
1941		31	[a]171	10	[a]172
--------	[a,b]151	Aug. 6	[a]172	Oct. 8	[a]171
1943		13	[a]170	Nov. 5	[a]166
July 6	[a]170	19	[a]172	Dec. 10	[a]165

TABLE 17—*Continued*

6S2E-4. U. S. Industrial Chemical Co.'s well 3700—*Continued*

Date	Depth to water	Date	Depth to water	Date	Depth to water
1944		1944		1945	
Jan. 22	82	Oct. 26	[a]166	Mar. 1	[a]157
29	84	Nov. 2	[a]170	15	[a]160
Feb. 19	83	9	[a]165	22	[a]160
Mar. 4	83	16	[a]158	Apr. 6	[a]154
11	83	23	[a]161	20	[a]148
18	82	30	[a]164	27	[a]151
Apr. 8	81	Dec. 22	[a]161	May 4	[a]153
22	81	29	[a]160	11	[a]152
29	82	1945		18	[a]151
May 13	81	Jan. 4	[a]155	25	[a]148
20	82	11	[a]160	June 1	[a]152
27	79	18	[a]154	15	[a]153
June 10	81	25	[a]159	22	[a]154
17	80	Feb. 1	[a]155	July 6	[a]151
Sept. 15	[a]182	8	[a]156	Aug. 3	[a]148
Oct. 5	[a]159	15	[a]162	31	[a]142
19	[a]170	22	[a]158	Oct. 12	[a]137

[a]*Well pumping at time of measurement.*
[b]*Water level reported.*

6S2E-6. U. S. Industrial Chemical Co.'s well 1325. In Baltimore, 100 feet east of well 6S2E-1, in the same well field. Unused drilled industrial well, diameter 8 inches, depth 228 feet. Measuring point, top of air line, 3.70 feet above land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1934		1943		1943	
--------	[b]65	Aug. 13	99.42	Dec. 10	105.48
1943		19	99.64	1944	
July 6	96.97	26	100.07	Jan. 15	94.06
14	97.19	Sept. 2	100.58	22	87.72
21	97.64	10	101.06	29	86.85
31	98.52	Oct. 8	102.69	Feb. 19	85.96
Aug. 6	98.76	Nov. 5	104.03	Mar. 4	84.95

TABLE 17 – *Continued*

6S2E-6. U. S. Industrial Chemical Co.'s well 1325 – *Continued*

Date	Depth to water	Date	Depth to water	Date	Depth to water
1944		1944		1945	
Mar. 11	83.74	Nov. 2	122.36	June 15	118.40
18	81.88	9	123.13	22	119.75
Apr. 8	80.77	16	120.75	July 6	119.05
22	79.15	23	121.45	13	79.26
29	79.72	30	122.40	20	115.99
May 13	80.68	Dec. 22	124.13	27	120.85
20	81.03	29	122.74	Aug. 3	120.01
27	80.85	1945		10	117.47
June 3	80.08	Jan. 4	115.07	17	106.92
10	81.01	11	121.92	24	118.70
17	78.75	18	124.00	31	118.46
23	79.89	24	123.66	Sept. 7	118.83
July 3	74.77	Feb. 1	119.42	14	119.46
7	70.80	8	118.39	21	116.37
14	63.78	15	120.68	28	115.18
21	75.34	22	121.15	Oct. 5	113.38
28	78.41	Mar. 1	122.25	12	110.54
Aug. 4	79.14	15	121.94	26	74.10
11	80.17	22	122.04	Nov. 2	71.07
18	78.13	Apr. 6	122.36	9	71.54
25	87.00	13	112.65	16	73.24
Sept. 1	81.43	20	110.80	23	72.36
8	118.83	27	108.86	30	73.84
15	112.89	May 4	114.87	Dec. 7	74.53
Oct. 5	109.47	11	116.94	17	73.20
12	110.54	18	117.74	21	71.20
19	117.70	25	118.17	28	72.47
26	121.76	June 1	118.36		

[b]*Water level reported.*

TABLE 17—*Continued*

6S2E-9. U. S. Industrial Chemical Co.'s well 3929. In Baltimore, at Benhill and Andard Streets, 5.30 miles south and 1.69 miles east from Washington Monument. Used drilled industrial well, diameter 10 inches, depth 293.5 feet.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1940		1941		1945	
October	[a]106	February	[b]103	Apr. 25	[b]90
do	[ab]179	do	[ab]179	May 4	[a]124

[a]*Well pumping at time of measurement.*
[b]*Water level reported.*

Baltimore County

Bal-Ef-16. Water hole. King Avenue, 0.1 mile southeast of Babikow Road. Longitude 76°28'58", latitude 39°21'35". Used for fire protection, concrete casing 3 feet in diameter, depth 7.5 feet. Measuring point, top of casing, at land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1944		1945		1945	
Nov. 18	7.13	Jan. 31	4.24	May 2	4.22
Dec. 2	4.05	Feb. 12	3.96	Aug. 3	4.17
19	4.11				

TABLE 17 – *Continued*

Bal-Ef 19. United Clay Mines Corp. Between Highway 40 and Baltimore & Ohio Railroad at Poplar. Longitude 76°27'20", latitude 39°21'05". Unused drilled industrial well, diameter 6 inches, depth 66 feet. Measuring point, top of casing, at land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1944		1945		1945	
Nov. 18	60.05	Jan. 31	60.04	May 2	59.70
Dec. 2	60.34	Feb. 12	60.05	Aug. 3	59.29
19	60.12				

Bal-Fe 19. Paul Jones & Co., Inc. Dundalk. South of Baltimore & Ohio Railroad tracks, 150 feet east of Willow Spring Street. Unused drilled industrial well, diameter 8 inches, depth 402 feet. Measuring point, top of casing, 1.00 foot above land surface. Automatic water-stage recorder installed Jan. 25, 1944. Water level, in feet below land surface datum, 1941: [b]98.

Daily highest and lowest water levels, in feet below land-surface datum (From recorder charts)

Date	Depth to water		Date	Depth to water		Date	Depth to water	
	Low	High		Low	High		Low	High
1944			1944			1944		
Jan. 25	88.63	88.30	Feb. 6	87.58	87.32	Feb. 20	88.10	87.52
26	88.55	88.05	7	87.42	86.92	21	87.76	87.31
27	88.67	88.05	8	88.22	87.41	22	88.06	87.76
28	88.05	87.71	9	88.11	87.94	23	88.09	87.37
29	88.14	87.56	10	88.20	87.50	24	88.40	89.01
30	87.63	87.19	11	88.32	87.95	25	88.67	87.86
31	87.44	86.93	12	88.14	87.59	26	88.77	88.00
Feb. 1	87.44	87.20	15	88.00	87.31	27	88.01	87.40
2	87.49	87.22	16	88.29	87.62	28	87.74	87.30
3	87.67	87.09	17	88.49	87.91	29	87.93	87.49
4	87.75	87.00	18	88.18	87.82	Mar. 1	88.44	87.60
5	87.67	87.45	19	88.46	88.10	2	88.89	88.20

TABLE 17 — *Continued*

Bal-Fe 19. Paul Jones & Co., Inc. — *Continued*

Date		Depth to water Low	High	Date		Depth to water Low	High	Date		Depth to water Low	High
1944				1944				1944			
Mar.	3	88.69	88.37	Apr.	10	86.96	86.57	May	18	88.92	88.66
	4	88.72	88.25		11	87.39	86.96		19	88.95	88.58
	5	88.25	87.42		12	87.33	86.92		20	88.89	88.37
	6	87.76	87.17		13	87.57	87.23		21	88.41	87.56
	7	87.98	87.54		14	87.57	87.18		22	88.42	87.51
	8	88.02	87.58		15	87.47	86.83		23	88.74	88.31
	9	88.37	87.83		16	86.83	85.65		24	88.91	88.34
	10	88.70	88.01		17	86.48	85.59		25	89.32	88.71
	11	88.79	88.13		18	87.19	86.48		26	89.46	88.87
	12	88.13	87.00		19	87.27	86.76		27	88.90	88.05
	13	87.63	86.84		20	87.47	87.09		28	88.05	86.15
	14	88.15	87.63		21	87.36	86.93		29	86.72	85.94
	15	88.19	87.67		22	87.50	87.18		30	87.18	86.72
	16	88.16	87.56		23	87.18	86.48		31	87.67	87.16
	17	87.67	87.46		24	86.80	86.39	June	1	88.17	87.56
	18	87.82	87.40		25	87.01	86.70		3	88.18	87.72
	19	87.40	86.12		26	87.17	86.58		4	87.72	86.86
	20	87.55	86.15		27	87.69	87.16		5	87.50	86.63
	21	88.10	87.42		28	88.00	87.68		6	87.71	87.48
	22	88.63	88.10		29	88.00	87.30		7	87.95	87.40
	23	88.10	87.81		30	87.30	86.84		8	88.11	87.62
	24	88.54	87.95	May	1	86.92	86.54		9	88.05	87.51
	25	88.63	88.29		2	87.50	86.91		10	88.24	87.88
	26	88.37	88.01		3	87.67	87.11		11	88.04	87.32
	27	88.01	87.59		4	87.72	87.49		12	87.58	87.06
	28	88.71	87.82		5	88.33	87.48		13	87.94	87.45
	29	88.30	87.52		6	88.47	87.96		14	88.04	87.42
	30	88.00	87.53		7	87.96	87.18		15	87.85	87.24
	31	87.93	87.55		8	87.73	87.06		16	87.67	87.14
Apr.	1	88.39	87.85		9	88.40	87.63		17	87.79	87.43
	2	88.30	87.73		10	87.92	88.15		18	87.43	86.54
	3	87.94	87.55		11	88.73	88.05		19	86.57	86.40
	4	88.15	87.80		12	89.22	88.65		20	86.63	86.12
	5	88.02	87.60		13	89.27	88.97		21	86.43	86.00
	6	88.00	87.55		14	89.16	88.45		22	87.06	86.28
	7	88.32	87.85		15	88.45	88.22		23	87.13	86.89
	8	88.39	88.08		16	88.82	88.37		24	87.00	86.42
	9	87.86	86.90		17	88.80	88.46		25	86.42	85.10

TABLE 17—*Continued*

Bal-Fe 19. Paul Jones & Co., Inc.—*Continued*

Date		Depth to water Low	High	Date		Depth to water Low	High	Date		Depth to water Low	High
1944				1944				1944			
June	26	85.71	85.00	Aug.	3	87.40	86.82	Sept.	10	87.60	87.46
	27	86.11	85.67		4	88.23	87.20		11	87.98	87.40
	28	86.68	86.11		5	88.57	87.93		12	87.96	87.84
	29	86.90	86.60		6	88.11	86.91		13	87.95	87.51
	30	87.14	86.62		7	87.73	86.88		14	87.70	87.38
July	1	86.62	85.15		8	88.23	87.53		15	87.90	87.70
	2	85.15	84.31		9	88.40	87.95		16	88.22	87.80
	3	84.31	83.79		10	88.39	87.94		17	88.38	87.68
	4	84.25	83.39		11	88.47	88.19		18	87.87	87.62
	5	83.84	83.09		12	88.65	88.09		19	87.90	87.62
	6	84.57	83.84		13	88.09	86.39		20	87.95	87.78
	7	85.53	84.57		14	87.47	86.36		21	87.85	87.73
	8	85.54	85.02		15	88.00	87.45		22	88.15	87.85
	9	85.02	84.08		16	88.10	87.91		23	88.41	88.15
	10	84.44	83.91		17	88.33	87.98		24	88.46	88.11
	11	85.28	84.44		18	88.73	88.13		25	88.15	87.73
	12	85.45	85.08		19	88.93	88.35		26	88.04	87.80
	13	85.95	85.27		20	88.35	86.05		27	88.05	87.95
	14	86.05	85.57		21	87.06	86.04		28	88.02	87.73
	15	85.94	85.55		22	87.84	87.04		29	87.85	87.67
	16	85.62	85.19		23	87.87	87.47		30	87.87	87.65
	17	85.81	84.95		24	88.01	87.47	Oct.	1	87.72	87.14
	18	85.90	85.39		25	88.10	87.70		2	87.15	86.89
	19	86.22	85.74		26	88.35	87.86		3	87.25	86.89
	20	86.46	85.73		27	87.86	85.92		4	87.20	86.99
	21	86.45	86.00		28	87.03	85.92		5	87.39	87.03
	22	86.41	85.82		29	87.45	86.81		6	87.36	87.06
	23	85.82	84.50		30	87.63	87.34		7	87.37	87.01
	24	85.54	84.30		31	87.79	87.31		8	87.35	86.81
	25	86.67	85.54	Sept.	1	87.94	87.44		9	87.09	86.61
	26	86.95	86.56		2	87.93	87.23		10	87.42	86.89
	27	87.11	86.61		3	87.23	86.10		11	87.67	87.30
	28	87.27	86.95		4	86.33	86.01		12	87.73	87.46
	29	87.53	86.86		5	86.91	86.22		13	87.69	87.38
	30	86.86	86.50		6	87.62	86.83		14	87.46	87.31
	31	86.74	86.16		7	87.81	87.56		15	87.69	86.91
Aug.	1	87.20	86.69		8	87.77	87.54		16	87.32	86.90
	2	87.20	86.80		9	87.80	87.60		17	87.01	86.54

TABLE 17 – *Continued*

Bal-Fe 19. Paul Jones & Co., Inc. – *Continued*

Date	Depth to water Low	Depth to water High	Date	Depth to water Low	Depth to water High	Date	Depth to water Low	Depth to water High
1944			1944			1945		
Oct. 18	87.25	86.25	Nov. 30	87.71	87.49	Feb. 13	83.09	82.41
19	86.25	85.87	Dec. 1	88.10	87.61	15	83.12	82.44
20	85.95	84.93	2	88.25	87.25	16	83.20	82.20
21	84.97	84.69	3	88.05	87.76	17	84.61	83.20
22	85.05	84.55	4	87.76	87.37	18	84.55	83.98
23	84.94	84.55	5	87.58	87.36	19	84.99	84.22
24	85.94	84.67	6	87.46	86.93	20	85.50	84.78
25	86.75	85.94	7	87.19	86.79	Mar. 1	85.70	85.53
26	87.27	86.64	8	87.26	87.11	2	85.67	84.98
27	87.14	86.09	9	89.11	86.65	3	85.29	84.72
28	86.44	85.88	10	87.13	86.84	4	85.43	84.62
29	87.18	86.41	11	86.93	86.22	5	85.06	84.46
30	87.60	86.97	12	86.27	86.06	6	84.46	83.45
31	87.95	87.39	13	86.36	86.04	7	83.60	83.40
Nov. 1	87.92	87.59	14	87.04	86.27	8	83.76	83.60
2	88.24	87.74	15	87.27	87.02	9	83.79	83.57
3	88.35	88.07	16	87.25	87.09	10	83.81	83.41
4	88.20	87.73	17	87.12	86.39	11	83.90	82.80
5	87.94	87.33	18	86.82	86.41	12	83.04	82.60
6	87.69	87.19	19	87.27	86.81	13	82.77	82.22
7	87.83	87.52	20	87.53	87.27	14	83.06	82.50
8	87.73	87.40	21	87.96	87.53	15	83.65	83.06
9	87.58	87.27	22	88.37	87.96	16	83.66	83.32
10	87.41	87.19	23	88.73	88.11	17	83.58	83.25
11	87.64	87.22	24	87.73	87.35	18	83.43	82.75
12	87.62	87.48	25	88.73	87.35	19	83.01	82.58
13	87.51	87.29	29	86.39	86.30	20	84.27	82.94
14	87.65	87.35	30	86.40	86.10	21	84.42	83.96
15	87.65	87.36	31	86.10	84.43	22	84.61	84.14
16	87.38	87.15	1945			23	84.63	84.34
17	87.81	87.22	Jan. 1	86.52	83.85	24	84.69	84.25
18	87.81	87.57	2	83.85	82.94	25	84.58	84.00
19	87.60	87.31	3	83.97	82.94	26	84.13	83.28
20	87.31	87.09	4	85.09	84.76	27	83.94	83.15
21	87.57	87.03	5	86.16	85.09	28	84.76	83.94
22	88.02	87.57	6	86.65	85.80	29	85.00	84.56
23	88.00	87.35	7	86.40	85.37	30	85.21	84.50
24	87.38	87.27	8	86.44	85.35	31	84.50	83.35
25	87.79	87.37	Feb. 8	84.50	84.34	Apr. 1	83.57	83.13
26	87.72	87.44	9	84.42	84.11	2	83.40	83.11
27	87.47	87.24	10	84.24	83.11	3	83.41	82.93
28	87.79	87.21	11	83.11	82.40	4	83.29	82.97
29	87.76	87.61	12	82.90	82.38	6	83.73	83.67

TABLE 17 -- *Continued*

Bal-Fe 19. Paul Jones & Co., Inc. - *Continued*

Date	Depth to water Low	High	Date	Depth to water Low	High	Date	Depth to water Low	High
1945			1945			1945		
Apr. 7	83.68	83.10	May 13	84.43	83.83	June 18	85.87	85.71
8	83.23	82.25	14	84.17	83.90	19	86.10	85.77
9	82.25	81.65	15	84.31	84.14	20	86.17	85.91
10	82.19	81.61	16	85.41	84.26	21	86.27	86.05
11	82.20	81.75	17	86.02	85.41	22	86.24	86.11
12	81.77	81.29	18	86.31	85.70	23	86.19	86.01
13	81.41	81.10	19	85.70	84.64	24	86.10	85.81
14	82.13	81.10	20	84.64	83.38	25	86.00	85.84
15	82.21	81.60	21	83.38	83.01	26	86.15	85.52
16	82.57	82.17	22	84.23	83.31	27	86.77	86.15
17	82.27	81.91	23	84.33	84.03	28	86.85	86.77
18	82.24	81.93	24	84.89	84.31	July 3	87.40	87.32
19	82.61	82.13	25	85.40	84.89	4	87.46	87.09
20	82.50	82.25	26	85.63	85.33	5	87.27	87.07
21	82.45	82.22	27	85.42	84.93	6	87.28	87.20
22	82.80	82.28	28	85.19	84.83	7	87.33	87.24
23	82.28	82.02	29	85.20	84.85	8	87.26	86.09
24	82.67	82.08	30	85.26	85.11	9	86.61	86.05
25	82.83	82.42	31	85.71	85.22	10	86.74	86.49
26	82.80	82.43	June 1	86.28	85.69	11	86.99	86.74
27	83.14	82.42	2	86.56	86.07	13	87.13	86.94
28	83.13	83.03	3	86.76	86.44	14	87.12	86.71
29	83.12	82.65	4	86.71	86.52	15	86.71	85.63
30	82.95	82.47	5	87.03	86.55	16	86.10	85.63
May 1	83.92	82.95	6	87.31	86.89	20	86.20	86.10
2	84.80	83.92	7	87.41	87.17	21	86.20	85.70
3	84.67	84.18	8	87.44	87.18	22	85.70	84.11
4	84.93	84.13	9	87.50	87.22	23	84.61	84.11
5	85.37	84.70	10	87.31	86.69	24	84.64	84.42
6	84.70	84.08	11	86.92	86.67	25	84.56	84.04
7	84.18	83.92	12	86.82	86.47	26	84.13	83.81
8	84.50	83.95	13	86.60	86.48	27	84.15	83.88
9	84.52	83.87	14	86.68	86.47	28	84.17	83.53
10	84.56	84.21	15	86.50	86.40	29	83.53	82.95
11	84.72	84.25	16	86.40	86.27	30	84.27	83.20
12	84.67	84.42	17	86.35	85.74	31	84.58	84.27

TABLE 17 – *Continued*

Bal-Fe 19. Paul Jones & Co., Inc. – *Continued*

Date	Depth to water		Date	Depth to water		Date	Depth to water	
	Low	High		Low	High		Low	High
1945			1945			1945		
Aug. 1	84.68	84.45	Sept. 6	82.96	82.37	Oct. 12	80.48	79.97
2	85.05	84.67	7	84.25	83.67	13	80.16	79.51
3	84.96	84.74	8	83.15	82.69	14	79.69	79.05
4	84.89	84.32	9	82.69	81.97	15	80.22	79.24
5	84.32	83.21	10	82.57	81.87	19	82.02	81.86
6	83.28	83.18	11	82.71	82.09	20	82.27	80.60
7	83.49	83.19	12	82.95	82.12	21	80.60	79.63
8	83.62	83.28	13	83.16	82.67	22	80.77	79.70
9	83.68	83.28	14	82.87	82.41	23	81.07	80.70
10	83.75	83.58	15	82.79	82.38	24	81.35	81.02
11	84.03	83.75	16	82.58	81.52	26	81.50	81.34
12	84.19	83.72	17	81.64	81.19	27	81.60	81.20
13	84.08	83.73	18	81.23	80.51	28	81.20	79.95
14	84.36	83.99	19	80.88	80.34	29	80.67	79.98
15	84.23	83.68	20	80.89	80.52	30	81.18	80.66
16	83.68	83.16	21	80.67	80.41	31	81.31	80.74
17	83.41	83.17	22	81.07	80.59	Nov. 1	81.32	80.88
18	83.57	83.11	23	80.76	80.38	2	81.80	80.96
19	83.24	82.96	24	80.49	80.26	3	81.70	80.20
20	83.25	82.91	25	80.81	80.12	4	80.20	79.01
21	83.39	83.14	26	81.00	80.34	5	80.28	79.26
22	83.52	83.14	27	81.04	80.65	6	81.35	80.16
23	83.72	83.38	28	80.96	80.63	7	81.69	81.04
24	83.86	83.43	29	80.71	80.15	8	81.83	81.35
25	83.85	83.36	30	80.15	79.49	9	81.91	81.37
26	83.40	82.93	Oct. 1	79.47	78.75	10	81.76	80.57
27	83.45	83.01	2	79.23	78.62	11	80.57	78.90
28	83.69	83.38	3	79.56	78.97	12	79.83	79.01
29	83.96	83.58	4	79.63	79.39	13	81.77	79.83
30	84.30	83.85	5	80.13	79.27	14	80.82	80.61
31	84.54	84.20	6	80.23	79.29	15	81.51	80.81
Sept. 1	84.48	83.51	7	79.75	79.27	16	81.52	81.30
2	83.51	82.70	8	80.05	79.75	17	81.52	80.71
3	82.70	82.25	9	80.33	79.82	18	80.71	79.79
4	82.59	82.13	10	80.57	80.18	19	80.46	79.75
5	82.59	82.46	11	80.51	79.88	20	81.37	80.46
						21	81.74	81.18

TABLE 17 — *Continued*

Bal-Fe 19. Paul Jones & Co., Inc. — *Continued*

Date	Depth to water Low	Depth to water High	Date	Depth to water Low	Depth to water High	Date	Depth to water Low	Depth to water High
1945			1945			1945		
Nov. 22	81.68	80.90	Dec. 5	80.79	80.41	Dec. 20	82.32	81.05
23	81.19	80.66	6	80.73	80.24	21	81.49	81.95
24	81.33	81.01	7	80.88	80.54	22	81.44	80.74
25	81.36	80.28	8	81.18	80.86	23	80.85	79.93
26	80.44	80.03	9	80.86	79.84	24	79.95	79.52
27	80.40	80.10	10	80.50	79.78	25	79.66	78.55
28	80.38	80.04	11	81.31	80.50	26	78.85	78.21
29	80.68	80.12	12	81.56	81.31	27	79.65	78.80
30	81.12	80.35	13	81.42	80.83	28	80.48	79.65
Dec. 1	81.03	80.23	14	81.23	80.65	29	80.50	80.01
2	80.23	78.92	17	81.23	80.79	30	80.51	79.20
3	79.84	78.93	18	81.41	81.08	31	79.54	78.78
4	80.72	79.77	19	81.42	81.22			

[b]*Water level reported.*

Bal-Ff 1. City of Baltimore, Back River Sewage Disposal Plant. Longitude 76°29'45", latitude 39°17'55." Unused drilled well, diameter 6 inches, depth 156 feet. Measuring point, top of casing, at land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1909		1943		1944	
--------	[b]15	July 26	42.11	Jan. 8	43.50
1930		Aug. 5	43.85	15	43.07
--------	[b]80	11	42.62	22	43.70
1943		18	42.62	29	43.40
June 18	42.13	25	42.38	Feb. 5	43.58
22	41.27	Sept. 1	42.35	19	43.55
28	41.27	9	42.55	26	42.82
July 6	41.58	Oct. 8	42.18	Mar. 4	42.67
12	41.73	Nov. 4	42.20	11	43.25
19	42.05	Dec. 9	42.58	18	43.01

TABLE 17—*Continued*

Bal-Ff 1. City of Baltimore, Back River Sewage Disposal Plant—*Continued*

Date	Depth to water	Date	Depth to water	Date	Depth to water
1944		1944		1945	
Apr. 8	43.72	Nov. 2	44.69	June 1	43.02
15	42.76	9	43.28	15	42.96
22	42.72	16	43.86	22	43.07
29	42.98	23	42.64	July 6	42.96
May 6	43.15	30	43.34	13	42.52
13	42.73	Dec. 14	43.68	20	42.41
20	43.32	22	44.12	27	43.32
27	43.01	29	44.04	Aug. 3	42.20
June 3	42.40	1945		10	42.32
10	42.42	Jan. 4	43.63	17	42.31
17	42.42	11	43.42	24	42.13
23	43.59	18	43.76	31	42.25
30	43.23	25	43.95	Sept. 7	42.23
July 7	43.36	Feb. 1	44.06	14	41.87
13	42.72	8	43.41	21	41.99
21	43.55	15	43.32	28	42.28
28	43.22	22	43.43	Oct. 5	42.17
Aug. 4	43.96	Mar. 1	43.44	18	41.26
11	44.31	15	43.04	26	41.37
18	43.31	22	43.47	Nov. 2	42.14
25	43.75	30	42.99	9	41.38
Sept. 1	43.97	Apr. 6	43.52	16	41.54
8	44.35	13	43.03	23	41.99
15	43.32	20	43.47	30	41.39
22	43.55	27	43.40	Dec. 7	41.24
Oct. 5	43.60	May 4	42.43	17	41.55
12	44.00	11	43.01	21	41.85
19	44.26	18	42.65	28	41.55
26	43.31	25	42.89		

[b]*Water level reported.*

TABLE 17 – *Continued*

Bal-Gc 20. Calvert Distilling Co., St. Denis. In warehouse, 0.2 mile south of Baltimore & Ohio R.R. crossing. Unused drilled industrial well, diameter 10 inches, depth 104 feet. Measuring point, top of discharge pipe, 2.00 feet above land surface. Automatic water-stage recorder installed Nov. 14, 1944.

Daily highest and lowest water level, in feet below land-surface datum. (From recorder charts)

Date	Depth to water		Date	Depth to water		Date	Depth to water	
	Low	High		Low	High		Low	High
1944			1944			1945		
Nov. 14	40.74	40.73	Dec. 24	40.85	40.77	Jan. 22	40.27	39.79
15	40.73	40.52	25	40.84	40.38	23	39.92	39.77
16	40.70	40.52	26	41.05	40.38	24	40.01	39.73
17	40.97	40.70	27	41.06	40.30	25	40.29	40.01
18	41.07	40.97	28	40.79	40.23	26	40.25	40.17
19	41.12	40.93	29	40.90	40.79	27	40.34	40.25
20	40.93	40.48	30	40.79	40.66	28	40.28	40.02
21	-----	40.43	31	40.66	40.25	29	40.21	39.86
30	40.71	40.47	1945			30	40.31	40.13
Dec. 1	41.05	40.71	Jan. 1	40.25	39.57	31	40.34	40.14
2	41.24	41.05	2	40.77	40.20	Feb. 1	40.30	40.23
3	41.30	41.22	3	40.77	40.64	2	40.30	40.20
4	41.22	41.11	4	40.66	40.42	3	40.45	40.24
5	41.11	40.83	5	40.57	40.42	4	40.48	40.00
6	40.83	40.65	6	40.62	40.48	5	40.35	39.91
7	40.70	40.52	7	40.52	40.02	6	40.39	40.24
8	40.53	39.94	8	40.10	40.03	7	40.33	40.22
11	-----	39.68	9	40.40	40.08	15	40.11	39.89
12	40.11	39.61	10	40.59	40.40	16	40.19	39.87
13	40.46	40.11	11	40.72	40.53	17	40.23	40.11
14	40.71	40.46	12	40.71	40.23	18	40.38	40.15
15	40.80	40.50	13	40.23	40.17	19	40.64	40.38
16	40.50	40.29	14	40.27	40.15	20	40.56	40.23
17	40.55	40.42	15	40.39	40.22	21	40.34	40.09
18	40.55	40.31	16	40.23	40.07	22	40.09	39.70
19	40.75	40.29	17	40.49	40.22	23	40.21	39.80
20	40.82	40.39	18	40.58	40.44	24	40.47	40.21
21	40.73	40.34	19	40.44	40.29	25	40.54	40.41
22	41.00	40.73	20	40.37	40.30	26	40.41	39.70
23	40.99	40.77	21	40.39	40.26	27	40.12	39.65

TABLE 17—*Continued*

Bal-Gc 20. Calvert Distilling Co., St. Denis—*Continued*

Date	Depth to water Low	High	Date	Depth to water Low	High	Date	Depth to water Low	High
1945			1945			1945		
Feb. 28	40.18	39.86	Apr. 7	40.36	40.18	May 13	39.48	39.33
Mar. 1	40.19	39.86	8	40.18	39.98	14	39.62	39.48
2	40.15	39.79	9	40.02	39.96	15	39.59	39.47
3	39.84	39.57	10	40.06	39.98	16	39.61	39.54
4	40.12	39.84	11	40.03	39.92	17	39.62	39.47
5	40.15	39.84	12	39.92	39.82	18	39.48	39.31
6	39.84	39.36	13	39.84	39.65	19	39.79	39.45
7	39.99	39.43	14	39.74	39.63	20	39.83	39.71
8	40.08	39.91	15	39.88	39.74	21	39.75	39.59
9	39.96	39.96	16	39.91	39.74	22	39.69	39.43
10	39.96	39.77	17	39.74	39.50	23	39.83	39.69
11	40.11	39.89	18	39.77	39.53	24	39.93	39.83
12	40.12	38.88	19	39.96	39.77	25	39.94	39.86
13	40.01	39.88	20	39.87	39.63	26	39.88	39.83
14	40.00	39.91	21	39.68	39.35	27	39.83	39.81
15	39.93	39.79	22	39.83	39.68	28	39.82	39.46
16	39.80	39.71	23	39.81	39.59	29	39.54	39.38
17	39.83	39.67	24	39.59	39.42	30	39.57	39.38
18	40.09	39.83	25	39.42	39.14	31	39.65	39.48
19	40.05	39.67	26	39.33	39.00	June 1	39.70	39.62
20	39.67	39.45	27	39.60	39.30	26	39.64	39.52
21	39.49	39.12	28	39.64	39.52	28	39.64	39.63
22	39.57	39.28	29	39.58	39.50	29	39.70	39.64
23	39.64	39.47	30	39.58	39.52	30	39.76	39.70
24	39.89	39.56	May 1	39.65	39.51	July 1	39.76	39.73
25	40.03	39.89	2	39.68	39.63	2	39.76	39.67
26	39.98	39.86	3	39.65	39.25	6	39.76	39.70
28	39.94	39.86	4	39.30	39.24	7	39.82	39.76
30	39.75	39.69	5	39.38	39.30	8	39.89	39.82
31	39.73	39.28	6	39.51	39.38	9	39.85	39.70
Apr. 1	39.93	39.73	7	39.55	39.45	10	39.75	39.54
2	39.85	39.48	8	39.65	39.34	11	39.86	39.64
3	39.92	39.53	9	39.82	39.65	13	39.92	39.91
4	39.93	39.53	10	39.75	39.16	14	39.91	39.76
5	40.12	39.46	11	39.71	39.43	15	39.78	39.71
6	40.32	40.12	12	39.70	39.43	16	40.02	39.78

TABLE 17—*Continued*

Bal-Gc 20. Calvert Distilling Co., St. Denis—*Continued*

Date	Depth to water Low	Depth to water High	Date	Depth to water Low	Depth to water High	Date	Depth to water Low	Depth to water High
1945			1945			1945		
July 17	40.05	40.02	Sept. 5	39.65	39.62	Oct. 17	39.35	39.16
18	40.03	39.89	6	39.65	39.58	18	39.43	39.33
19	39.89	39.80	7	39.59	39.51	19	39.39	39.30
20	39.80	39.63	8	39.51	39.41	20	39.50	39.33
21	39.64	39.50	9	39.46	39.41	21	39.50	39.50
22	39.50	39.35	10	39.41	39.24	22	39.50	39.38
23	39.43	39.36	11	39.24	39.15	23	39.40	39.28
24	39.51	39.43	12	39.52	39.24	24	39.52	39.34
25	39.49	39.36	13	39.60	39.51	25	39.52	39.49
26	39.42	39.30	14	39.58	39.46	26	39.56	39.39
27	39.43	39.37	15	39.57	39.45	27	39.77	39.56
28	39.43	39.27	16	39.79	39.57	28	39.77	39.72
29	39.47	39.27	17	39.80	39.67	29	39.77	39.69
30	39.63	39.47	18	39.67	39.31	30	39.70	39.52
31	39.63	39.53	19	39.42	39.32	31	39.52	39.40
Aug. 1	39.53	39.38	20	39.42	39.28	Nov. 1	39.50	39.40
2	39.38	39.26	21	39.49	39.28	2	39.48	39.33
3	39.27	39.15	22	39.70	39.49	3	39.40	39.30
4	39.46	39.27	23	39.67	39.61	4	39.40	39.40
5	39.51	39.44	24	39.61	39.52	5	39.65	39.40
6	39.44	39.10	25	39.52	39.44	6	39.86	39.65
7	39.23	39.12	26	39.58	39.44	7	39.86	39.77
8	39.44	39.23	27	39.59	39.53	8	39.79	39.72
9	39.50	39.44	28	39.58	39.46	9	39.79	39.72
10	39.50	39.46	29	39.61	39.38	10	39.86	39.78
18	39.38	39.29	30	39.76	39.61	11	39.86	39.86
21	39.38	39.35	Oct. 1	39.74	39.31	12	39.86	39.69
22	39.37	39.29	2	39.31	39.08	13	39.69	39.43
24	39.36	39.35	3	39.69	39.22	14	39.43	39.24
25	39.35	39.13	4	39.77	39.63	15	39.78	39.27
26	39.37	39.19	5	39.63	39.43	16	39.89	39.73
31	39.55	39.54	12	39.14	39.08	17	39.73	39.57
Sept. 1	39.54	39.30	13	39.37	39.14	18	39.71	39.57
2	39.37	39.28	14	39.40	39.35	19	39.71	39.51
3	39.65	39.37	15	39.41	39.37	20	39.72	39.51
4	39.69	39.62	16	39.37	39.13	21	39.78	39.51

TABLE 17—*Continued*

Bal-Gc 20. Calvert Distilling Co., St. Denis—*Continued*

Date	Depth to water		Date	Depth to water		Date	Depth to water	
	Low	High		Low	High		Low	High
1945			1945			1945		
Nov. 23	39.40	39.30	Dec. 5	39.48	39.28	Dec. 20	39.32	39.25
24	39.41	39.40	7	39.04	38.99	21	39.61	39.27
25	39.68	39.38	8	39.33	39.04	22	39.61	39.41
26	39.89	39.68	9	39.33	39.08	23	39.71	39.56
27	39.89	39.64	10	39.11	39.08	24	39.65	39.56
28	39.64	39.06	11	39.49	39.11	25	39.58	38.77
29	39.20	39.01	12	39.57	39.49	26	39.07	38.76
30	39.46	39.20	13	39.52	39.27	27	39.44	39.07
Dec. 1	39.65	39.46	14	39.27	39.00	28	39.47	39.26
2	39.67	39.63	17	39.62	39.57	29	39.26	39.16
3	39.63	39.43	18	39.64	39.46	31	38.84	38.79
4	39.48	39.42	19	39.46	39.25			

Bal-Gf 1. Bethlehem Steel Co.'s well, Wire Mill 3, Sparrows Point. Unused drilled industrial well, diameter 12 to 6 inches, depth 260 feet. Measuring point, top of discharge pipe, 11.50 feet above land-surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1940		1941		1942	
--------	[b]89	Sept. 24	[b]94	December	[b]66
1941		1942		1943	
Apr. 27	[b]88	June	[b]79	January	[b]49
				Apr. 21	[b]43

[b]*Water level reported.*

TABLE 17—*Continued*

Bal-Gf 1. Bethlehem Steel Co.'s well, Wire Mill 3—*Continued*

Daily highest and lowest water levels, in feet below land-surface datum
(From recorder charts)

Date		Depth to water Low	High	Date		Depth to water Low	High	Date		Depth to water Low	High
1943				1943				1943			
May	7	40.53	.....	June	11	43.91	43.59	July	14	43.55	42.14
	8	41.25	39.62		12	43.59	43.15		15	43.60	42.75
	9	41.28	41.25		13	43.15	42.31		16	43.70	42.82
	10	41.28	39.28		14	42.42	42.02		17	43.81	43.07
	11	39.28	38.00		15	42.05	41.28		18	43.81	42.81
	12	38.00	37.25		16	41.90	41.08		19	43.21	42.49
	13	39.50	37.83		17	41.90	41.02		20	43.21	42.55
	15	43.50	41.35		18	42.45	40.92		21	43.54	42.68
	16	42.43	41.16		19	42.22	41.31		22	42.79	41.84
	17	41.16	39.87		20	41.72	40.46		23	42.03	41.27
	18	40.32	39.74		21	40.94	39.95		24	41.58	41.16
	19	40.83	39.94		22	40.94	40.16		25	41.31	40.95
	21	40.37	39.92		23	40.93	40.30		26	41.71	40.76
	22	41.24	39.90		24	41.75	40.47		28	42.17	41.35
	23	42.02	39.70		25	41.45	40.95		29	41.58	40.88
	24	42.76	41.75		26	41.15	40.72		30	41.27	40.75
	25	43.79	42.76		27	40.72	40.10		31	41.82	40.82
	26	44.80	43.55		28	40.55	39.68	Aug.	1	41.62	40.87
	27	45.18	44.55		29	40.81	39.93		2	41.06	40.57
	28	45.30	44.74		30	40.98	40.40		3	40.72	40.12
	29	45.04	44.34	July	1	40.96	40.10		5	39.67	39.23
	30	46.60	44.57		2	40.52	39.97		6	39.67	38.73
	31	47.19	46.15		3	40.59	40.06		7	39.70	38.53
June	1	47.46	46.56		4	40.27	39.40		8	39.10	38.25
	2	47.57	46.97		5	39.58	38.51		9	38.43	38.10
	3	48.00	47.08		6	39.94	39.38		10	38.10	37.67
	4	48.03	47.52		7	40.53	39.62		11	38.27	37.32
	5	48.00	47.38		8	40.44	39.38		12	37.80	37.08
	6	.....	47.86		9	41.16	39.87		13	37.50	36.84
	7	46.60	46.13		10	41.51	40.92		14	37.75	37.17
	8	46.20	44.60		11	41.43	40.88		15	37.87	36.95
	9	44.78	44.30		12	42.00	40.88		16	38.46	36.95
	10	44.50	43.74		13	42.80	41.61		17	37.60	36.79

TABLE 17—*Continued*

Bal-Gf 1. Bethlehem Steel Co.'s well, Wire Mill 3—*Continued*

Date	Depth to water Low	Depth to water High	Date	Depth to water Low	Depth to water High	Date	Depth to water Low	Depth to water High
1943			1943			1943		
Aug. 18	37.99	37.20	Sept. 23	44.06	41.60	Nov. 2	36.75	35.35
19	37.68	37.09	24	41.60	39.50	3	36.60	36.03
20	37.47	36.90	25	39.50	38.27	4	36.12	35.40
21	37.30	36.80	26	38.48	38.02	5	35.50	35.06
22	37.11	36.70	27	38.22	37.56	6	35.40	34.93
23	37.35	36.46	28	37.98	37.52	7	35.33	34.92
24	36.95	36.60	29	38.02	37.53	8	35.25	34.38
25	36.85	36.27	30	38.15	37.60	9	35.20	33.72
26	36.85	36.30	Oct. 1	38.35	36.55	10	35.35	34.63
27	36.85	36.25	2	37.24	36.85	11	35.43	34.70
28	36.85	36.18	3	38.24	37.00	12	35.43	34.18
29	36.76	35.94	4	39.18	37.80	13	35.18	34.35
30	36.60	35.90	5	38.35	37.47	14	35.53	34.82
31	36.68	36.05	6	37.83	37.47	15	35.06	33.71
Sept. 1	36.37	35.85	7	37.73	37.26	16	35.11	33.71
2	36.40	35.92	8	37.73	37.23	17	35.33	34.37
3	36.37	35.80	9	37.43	36.77	18	34.61	34.32
4	36.04	35.60	10	37.58	36.72	19	34.83	34.37
5	35.91	35.35	11	37.55	36.53	20	35.24	34.70
6	35.93	35.35	12	37.01	36.41	22	35.86	35.48
7	36.60	35.40	13	37.10	36.45	25	35.55	35.17
8	37.07	36.10	14	38.45	36.52	26	35.75	35.13
9	36.50	35.90	15	40.05	38.29	27	35.61	35.24
10	36.57	35.81	16	39.15	37.02	28	36.01	35.28
11	35.87	35.73	17	37.72	36.92	Dec. 7	36.05	35.67
12	36.50	35.79	18	38.98	36.93	8	36.02	35.37
13	36.70	35.62	19	38.98	37.80	9	36.06	35.52
14	36.73	36.10	20	37.80	37.00	10	36.15	35.53
15	36.62	35.70	21	37.04	36.35	11	36.35	35.95
16	39.30	35.78	22	36.68	36.33	12	36.35	35.42
17	42.55	39.30	23	36.62	.....	17	36.80	36.43
18	43.60	40.90	28	35.57	35.07	18	36.67	36.36
19	40.90	38.35	29	36.16	35.45	19	36.78	36.38
20	40.40	38.05	30	36.36	36.00	20	37.00	36.22
21	43.08	40.40	31	36.55	35.78	21	37.35	36.14
22	44.13	43.02	Nov. 1	36.18	35.37	22	37.12	36.43

TABLE 17—*Continued*

Bal-Gf 1. Bethlehem Steel Co.'s well, Wire Mill 3—*Continued*

Date	Depth to water Low	Depth to water High	Date	Depth to water Low	Depth to water High	Date	Depth to water Low	Depth to water High
1943			1944			1944		
Dec. 23	37.31	36.68	Feb. 2	36.75	36.00	Mar. 24	38.49	37.85
24	37.53	36.85	3	36.33	35.78	25	38.57	37.90
25	36.96	36.36	4	37.12	36.23	26	38.54	37.88
26	36.87	35.99	5	37.28	36.53	27	38.45	37.74
27	36.56	35.90	6	37.46	36.53	28	38.62	38.00
28	36.57	35.88	7	37.62	36.90	29	38.61	37.74
29	36.62	35.95	8	37.92	36.90	30	38.22	37.74
30	36.46	35.90	9	37.70	37.38	31	38.17	37.79
31	36.55	35.89	10	38.24	37.45	Apr. 1	38.23	37.67
1944			11	38.03	37.67	2	38.42	37.82
Jan. 1	36.65	36.09	12	38.47	37.87	3	38.42	37.80
2	36.56	36.15	14	38.40	38.00	4	37.95	37.30
3	36.44	35.70	15	38.93	38.00	5	38.51	37.77
6	36.94	36.55	16	39.00	38.75	6	38.38	37.68
7	37.00	36.43	17	38.95	38.15	7	38.51	37.50
8	37.05	36.42	18	38.76	38.07	8	38.28	37.95
9	36.98	36.35	19	39.07	38.58	9	38.47	37.69
10	36.70	36.20	20	38.85	38.19	10	37.93	37.33
11	36.68	36.25	29	37.58	.....	11	38.17	37.43
12	37.00	36.40	Mar. 6	38.79	38.53	12	37.88	36.85
13	37.00	36.70	7	38.75	38.23	13	38.16	37.63
14	37.05	36.73	8	38.67	38.23	14	41.07	37.20
17	36.70	36.40	9	38.97	38.27	15	42.98	41.07
18	36.88	36.60	11	39.28	38.86	16	44.37	42.98
19	36.80	36.28	12	39.17	38.65	17	45.52	44.32
20	36.47	35.92	13	39.05	38.63	18	45.80	44.00
21	36.66	36.07	14	39.13	38.60	19	44.00	40.70
22	36.87	36.32	15	38.65	38.16	20	40.70	39.08
23	36.78	36.25	16	38.45	37.93	21	39.13	38.52
24	36.95	36.33	17	38.57	37.68	22	38.95	37.94
25	36.87	36.15	18	38.63	38.12	23	38.22	37.53
26	36.75	36.20	19	39.08	38.22	24	38.03	37.19
27	36.76	35.98	20	38.23	37.68	25	37.76	37.05
28	36.47	35.89	21	38.81	38.00	26	37.70	37.06
29	36.51	36.01	22	38.80	38.18	27	37.73	36.92
Feb. 1	36.80	35.63	23	38.58	37.66	28	37.73	37.29

TABLE 17—*Continued*

Bal-Gf 1. Bethlehem Steel Co.'s well, Wire Mill 3—*Continued*

Date	Depth to water Low	Depth to water High	Date	Depth to water Low	Depth to water High	Date	Depth to water Low	Depth to water High
1944			1944			1944		
Apr. 29	37.71	37.41	June 7	38.95	37.75	July 13	40.39	39.55
30	37.58	37.18	8	39.13	38.38	14	40.07	39.64
May 1	37.69	37.08	9	38.76	38.07	15	39.64	39.22
2	38.12	37.50	10	38.59	37.93	16	39.37	38.74
3	43.40	37.78	11	40.04	38.20	17	39.17	38.47
4	49.70	43.40	12	40.04	38.38	18	39.11	38.33
6	56.03	55.55	13	38.75	38.09	19	38.63	37.92
7	56.15	55.13	14	38.73	38.23	20	38.23	37.67
8	56.52	55.96	15	38.61	38.06	21	38.43	37.90
9	56.63	55.95	16	38.56	38.03	22	38.43	37.83
10	57.08	56.32	17	39.05	38.12	23	38.12	37.59
11	57.30	56.68	18	39.06	38.43	24	38.87	37.33
12	57.65	56.25	19	39.84	38.15	25	39.24	37.93
13	56.25	48.15	20	40.38	39.00	26	39.48	38.28
14	48.15	44.45	21	40.53	39.52	27	39.49	38.35
15	44.45	42.38	22	40.24	39.18	28	39.81	38.62
16	42.42	41.14	23	40.37	39.08	29	40.01	38.74
17	41.38	40.38	24	41.08	39.09	30	40.00	38.90
18	40.71	39.27	25	40.64	39.61	31	38.90	38.15
19	40.25	39.20	26	39.61	38.98	Aug. 1	38.75	38.10
20	39.85	39.41	27	39.55	39.10	2	38.52	37.41
21	39.86	38.93	28	39.55	39.18	3	38.56	37.76
22	39.15	38.48	29	39.56	39.14	4	38.62	37.83
23	39.10	38.45	30	39.96	39.07	5	38.36	37.70
24	38.96	38.22	July 1	39.92	39.44	6	38.44	37.75
25	38.78	38.15	2	39.74	39.05	7	39.24	37.65
26	38.81	38.24	3	39.58	38.93	8	39.12	37.75
27	38.73	38.25	4	39.52	38.83	9	39.85	37.66
28	38.78	38.23	5	39.56	38.90	10	40.07	38.85
29	38.75	38.43	6	39.87	39.13	11	40.92	39.48
June 1	40.70	39.70	7	40.03	39.33	12	40.83	39.47
2	40.45	39.43	8	39.95	39.27	13	40.60	39.68
3	40.25	39.28	9	39.75	39.22	14	39.69	39.08
4	39.87	38.47	10	39.71	38.91	15	39.42	38.87
5	38.52	37.89	11	39.33	38.76	16	39.42	38.80
6	38.45	37.81	12	40.31	39.38	17	39.47	38.48

TABLE 17 — *Continued*

Bal-Gf 1. Bethlehem Steel Co.'s well, Wire Mill 3 — *Continued*

Date	Depth to water Low	High	Date	Depth to water Low	High	Date	Depth to water Low	High
1944			1944			1944		
Aug. 18	39.19	38.33	Sept. 23	37.90	37.24	Oct. 29	35.58	35.07
19	39.20	38.37	24	37.37	36.74	30	36.73	35.07
20	38.67	38.09	25	37.12	36.67	31	36.73	35.76
21	38.27	37.73	26	36.93	36.42	Nov. 1	37.05	35.88
22	39.26	37.72	27	36.79	36.25	2	37.05	36.33
23	39.07	38.42	28	36.50	36.22	3	36.71	35.80
24	39.03	38.42	29	36.62	35.98	4	36.18	35.28
25	38.73	38.20	30	36.62	35.92	5	36.22	35.28
26	39.12	38.03	Oct. 1	36.26	35.34	6	38.74	35.83
27	38.75	38.32	2	35.76	35.24	10	38.65	37.36
28	38.48	37.76	3	35.87	35.19	11	40.50	38.65
29	38.12	37.38	4	35.50	35.00	16	38.59	36.68
30	39.82	37.58	5	35.48	34.97	17	36.86	36.09
31	41.15	38.63	6	35.44	34.97	18	35.50	35.47
Sept. 1	41.72	39.91	7	35.41	34.88	19	35.76	35.10
2	43.11	41.72	8	35.50	34.86	20	35.45	35.07
3	42.35	39.54	9	35.63	35.22	21	36.04	35.12
4	39.73	38.32	10	35.49	35.18	22	36.55	35.30
5	38.66	37.89	11	35.85	35.47	23	35.97	35.38
6	38.41	37.63	12	35.92	35.68	24	35.72	35.30
7	38.38	37.75	13	35.93	35.38	25	35.68	35.11
8	38.49	37.86	14	35.58	35.21	26	35.23	34.68
9	38.30	37.75	15	36.72	35.58	27	34.92	34.08
10	38.00	37.70	16	36.58	35.63	28	35.03	34.32
11	39.59	37.28	17	36.34	35.79	29	34.85	34.17
12	39.42	37.76	18	36.07	35.39	30	34.90	34.14
13	37.95	37.16	19	35.83	35.40	Dec. 1	35.18	34.50
14	38.70	37.44	20	35.93	34.58	2	35.71	35.18
15	38.70	37.33	21	35.56	34.58	3	35.58	35.24
16	38.53	37.85	22	35.77	35.03	4	35.36	35.06
17	38.30	37.38	23	35.38	34.77	5	35.06	34.50
18	39.87	37.23	24	35.30	34.77	6	34.50	34.15
19	39.86	38.11	25	35.20	34.60	7	34.40	34.08
20	38.32	37.33	26	36.34	35.42	8	33.87	33.69
21	37.57	36.87	27	36.28	35.72	9	34.68	33.87
22	38.33	37.57	28	36.17	35.47	10	34.75	34.46

TABLE 17—*Continued*

Bal-Gf 1. Bethlehem Steel Co.'s well, Wire Mill 3—*Continued*

Date	Depth to water Low	High	Date	Depth to water Low	High	Date	Depth to water Low	High
1944			1945			1945		
Dec. 11	34.70	34.15	Jan. 15	34.56	34.02	Feb. 20	35.27	34.60
12	34.50	34.24	16	34.75	34.30	21	35.10	34.65
13	35.05	34.32	17	35.15	34.70	22	35.00	34.18
14	35.21	34.77	18	35.23	34.76	23	36.45	34.40
15	35.15	34.48	19	34.93	34.58	24	37.52	36.45
16	36.93	34.47	20	34.91	34.52	25	36.76	35.86
17	35.16	34.40	21	34.94	34.39	26	36.02	35.00
18	34.86	34.33	22	34.54	33.91	27	35.45	34.69
19	35.39	34.33	23	34.71	34.17	28	35.54	34.87
20	34.92	34.11	24	35.51	34.32	Mar. 1	35.54	34.91
21	35.38	34.09	25	35.81	35.18	2	35.21	34.63
22	35.52	34.91	26	35.55	35.07	3	34.90	34.52
23	34.91	34.66	27	35.69	35.18	4	35.27	34.73
24	34.89	34.60	28	35.67	35.05	5	34.95	34.63
25	34.83	34.25	29	35.42	34.97	6	34.92	34.22
26	35.35	34.52	30	35.56	35.00	7	35.18	34.58
27	35.35	34.45	31	36.25	35.06	8	35.17	34.82
28	35.33	34.56	Feb. 1	36.43	35.94	9	35.04	34.63
29	35.60	34.93	2	36.43	36.17	10	35.05	34.51
30	35.33	34.70	3	36.30	36.05	11	35.24	34.85
31	35.02	34.17	4	36.05	35.21	12	34.98	34.07
1945			5	35.83	35.00	13	35.06	34.38
Jan. 1	34.38	33.85	6	35.82	35.17	14	34.88	34.28
2	35.25	34.19	7	35.63	35.02	15	34.78	34.23
3	35.20	34.74	8	35.37	34.73	16	35.63	34.11
4	35.05	34.58	9	35.16	34.53	17	35.92	34.89
5	34.98	34.45	10	35.22	34.60	18	35.24	34.63
6	34.85	34.33	11	35.32	34.73	19	35.01	34.34
7	34.70	34.27	12	35.23	34.58	20	34.77	34.21
8	34.55	34.18	13	35.17	34.45	21	34.72	34.05
9	34.95	34.45	14	35.02	34.45	22	34.85	34.26
10	35.34	34.67	15	34.86	34.21	23	34.92	34.00
11	35.12	34.67	16	35.08	34.21	24	34.63	34.14
12	35.20	34.15	17	35.10	34.61	25	34.95	34.49
13	35.15	34.59	18	35.09	34.63	26	36.21	34.27
14	35.10	34.32	19	35.42	34.94	27	37.21	35.39

TABLE 17 — *Continued*

Bal-Gf 1. Bethlehem Steel Co.'s well, Wire Mill 3 — *Continued*

Date		Depth to water Low	High	Date		Depth to water Low	High	Date		Depth to water Low	High
1945				1945				1945			
Mar.	28	37.56	36.12	Mar	3	43.77	35.61	June	14	42.89	41.05
	29	37.61	35.93		4	47.38	43.77		15	41.05	38.25
	30	36.08	35.50		5	46.80	42.77		16	38.25	37.29
	31	35.73	34.97		12	36.24	35.69		17	37.41	36.68
Apr.	1	35.51	34.95		13	36.46	35.12		18	38.24	36.39
	2	35.10	34.65		14	36.58	35.52		19	36.57	36.35
	3	35.30	34.70		15	35.52	34.69		20	36.68	36.05
	4	34.74	34.47		16	35.04	34.49		21	36.65	36.17
	5	35.18	34.18		17	34.84	34.33		22	36.84	36.12
	6	35.70	35.18		18	34.69	34.20		23	36.85	36.29
	7	35.63	35.15		19	35.30	34.66		24	36.68	36.10
	8	35.60	35.07		20	35.30	34.32		25	36.30	35.52
	9	36.95	34.98		21	34.36	33.79		26	35.90	35.18
	10	37.77	35.99		22	34.55	33.92		27	35.10	34.67
	11	36.10	35.24		23	35.02	34.21		28	34.90	34.35
	12	35.60	34.99		24	35.24	34.49		29	35.06	34.28
	13	35.46	34.76		25	35.02	34.39	July	3	39.40	38.30
	14	35.22	34.53		26	36.86	33.90		4	38.30	36.52
	15	35.35	34.74		27	38.42	35.86		5	38.49	35.82
	16	35.00	34.38		28	37.61	35.69		6	41.79	38.49
	17	34.95	34.22		29	38.29	36.44		7	42.69	41.68
	18	35.64	34.68		30	39.60	36.89		8	43.02	40.41
	19	35.95	35.58		31	39.66	37.35		9	40.41	38.34
	20	35.53	34.54	June	1	37.39	36.02		10	42.10	40.27
	21	35.27	34.54		2	36.02	35.32		11	43.20	42.10
	22	35.44	34.94		3	35.59	34.83		12	43.27	42.60
	23	35.19	34.72		4	35.30	34.90		13	43.62	42.35
	24	34.88	34.08		5	36.10	34.77		14	42.35	38.73
	25	34.54	34.08		6	36.05	35.02		15	38.73	37.35
	26	34.44	33.98		7	35.38	34.68		16	40.44	37.23
	27	36.38	34.14		8	35.70	34.69		17	42.33	40.44
	28	36.47	35.35		9	35.77	35.13		18	43.38	42.16
	29	35.52	34.85		10	35.72	34.93		19	43.72	43.06
	30	37.85	34.57		11	37.84	34.78		20	44.03	43.28
May	1	38.71	37.85		12	41.10	37.84		21	44.19	43.58
	2	37.92	35.61		13	42.46	41.10		22	44.20	41.80

TABLE 17 — *Continued*

Bal-Gf 1. Bethlehem Steel Co.'s well, Wire Mill 3—*Continued*

Date	Depth to water Low	High	Date	Depth to water Low	High	Date	Depth to water Low	High
1945			1945			1945		
July 23	41.80	38.51	Aug. 28	35.87	34.25	Oct. 3	34.75	34.07
24	38.51	37.25	29	35.60	35.07	4	34.75	34.25
25	38.88	36.49	30	36.93	34.88	5	34.51	33.70
26	40.71	38.88	31	37.79	35.75	6	34.07	33.50
27	41.76	40.21	Sept. 1	37.41	35.48	7	33.90	33.50
28	42.43	41.23	2	35.63	35.01	8	34.18	33.22
29	42.88	39.62	3	35.77	34.95	9	34.23	33.18
30	40.98	39.35	4	35.18	34.45	10	34.75	33.87
31	41.67	40.92	5	34.78	34.22	11	36.17	34.39
Aug. 1	42.48	41.49	6	34.78	34.27	12	34.39	33.94
2	42.83	41.73	7	34.75	34.15	13	34.52	33.78
3	43.07	41.82	8	34.52	34.00	14	34.12	33.44
4	43.46	42.02	9	34.37	33.93	15	34.96	33.24
5	42.82	39.20	10	34.18	33.76	16	34.59	33.55
6	39.72	38.67	11	35.37	33.58	17	35.94	33.35
7	41.32	38.88	12	35.20	34.51	18	38.71	35.94
8	42.48	41.31	13	36.00	34.40	19	38.71	35.51
9	42.49	40.78	14	36.78	34.77	20	37.03	35.62
10	40.78	37.95	15	36.78	35.63	21	35.72	34.22
11	37.98	37.14	16	35.76	35.21	22	34.22	33.18
12	39.43	37.17	17	35.22	34.23	23	33.68	33.00
13	38.50	36.80	18	35.25	33.13	24	35.50	33.11
14	36.80	36.12	19	35.91	35.25	25	35.04	33.70
15	36.12	35.70	20	35.50	34.48	26	33.88	33.37
16	35.94	35.13	21	34.82	34.20	27	34.17	32.91
17	36.38	34.93	22	35.06	34.40	28	34.56	33.66
18	37.35	35.52	23	34.87	34.11	29	34.18	33.74
19	37.41	35.95	24	34.57	33.88	30	33.74	33.35
20	36.03	35.17	25	34.40	33.74	31	33.54	33.10
21	35.43	34.78	26	35.77	33.74	Nov. 1	33.81	33.25
22	35.25	34.65	27	36.00	34.90	2	33.55	32.74
23	35.41	34.80	28	35.09	34.60	3	33.30	32.98
24	35.46	34.40	29	34.65	34.09	4	33.55	33.22
25	34.99	34.39	30	35.00	34.40	5	33.80	32.80
26	35.22	34.28	Oct. 1	34.69	33.35	6	36.51	33.80
27	35.07	34.63	2	34.07	33.23	7	36.02	33.91

TABLE 17—*Continued*

Bal-Gf 1. Bethlehem Steel Co.'s well, Wire Mill 3—*Continued*

Date	Depth to water Low	Depth to water High	Date	Depth to water Low	Depth to water High	Date	Depth to water Low	Depth to water High
1945			1945			1945		
Nov. 8	34.05	33.15	Nov. 26	35.65	32.85	Dec. 13	33.67	33.09
9	33.41	32.88	27	34.60	33.38	14	33.22	32.68
10	33.62	32.88	28	33.93	32.79	17	33.58	32.89
11	33.45	32.96	29	33.44	32.76	18	33.72	33.02
12	32.98	32.59	30	33.68	33.35	19	33.59	32.94
13	32.77	32.23	Dec. 1	33.62	33.05	20	33.18	32.65
14	34.36	32.20	2	33.20	32.16	21	33.59	32.79
15	35.65	34.15	3	32.40	31.83	22	33.50	33.01
16	35.85	33.87	4	32.95	32.30	23	33.88	33.05
17	34.51	33.31	5	33.08	32.05	24	33.67	33.22
18	33.67	32.98	6	32.47	32.13	25	33.22	32.00
19	33.25	32.02	7	32.70	31.99	26	32.86	31.85
20	33.41	32.05	8	32.82	32.02	27	33.25	32.66
21	33.25	32.35	9	32.71	32.25	28	33.52	32.95
22	33.58	32.08	10	33.02	32.25	29	33.15	32.66
23	34.00	32.88	11	33.31	32.78	30	32.78	31.82
24	33.46	32.85	12	33.42	32.78	31	32.55	32.00
25	33.24	32.63						

Bal-Gf 3. Bethlehem Steel Co.'s well, Wire Mill 5, Sparrows Point. Unused drilled industrial well, diameter 12 to 4½ inches, depth 622 feet. Measuring point, top of air line, 12.00 feet above land-surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1926		1940		1942	
--------	[b]30	December	[b]148	June	[b]133
1935		1941		1943	
--------	[b]59	Apr. 27	[b]153	January	[b]88
1939		June	[b]153	May 10	[b]93
October	[b]142	Sept. 24	[b]143.5	10	[a, b]148

TABLE 17—*Continued*

Bal-Gf 3. Bethlehem Steel Co.'s well, Wire Mill 5—*Continued*

Date	Depth to water	Date	Depth to water	Date	Depth to water
1942		1943		1944	
May 28	92	July 12	98	Jan. 8	95
June 7	89	19	93	Feb. 5	96
15	93	Aug. 4	95	1945	
22	95	Sept. 8	80	June 4	[b]89
28	100	Oct. 7	109	4	[b]144
July 6	99			Oct. 16	92

[a]*Well pumping at time of measurement.*
[b]*Water level reported.*

Bal-Gf 4. Bethlehem Steel Co.'s well, Wire Mill 6, Sparrows Point. Unused drilled industrial well, diameter 12 to 6 inches, depth 440 feet. Measuring point, top of discharge pipe, 11.10 feet above land-surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1938		1943		1943	
--------	[b]91	May 10	[b]93.1	Aug. 18	99.01
1940		28	95.20	25	97.14
January	[b]139	June 7	91.41	Sept. 1	96.83
1941		15	95.24	8	96.93
Apr. 27	[b]144	22	95.34	Oct. 7	104.45
Sept. 24	[b]130	28	99.39	Nov. 4	100.46
1942		July 6	99.88	Dec. 9	103.15
June	[b]136	12	100.79	1944	
November	[b]133	19	100.65	Feb. 5	101.35
1943		26	89.07	1945	
January	[b]109	Aug. 4	99.87	June 4	[b]92
April	[b]91	11	98.17	Oct. 16	93.25

[b]*Water level reported.*

TABLE 17 — *Continued*

Bal-Gf 6. Bethlehem Steel Co.'s well, Wire Mill 8, Sparrows Point. Unused drilled industrial well, diameter 12 to 4½ inches, depth 625 feet. Measuring point, top of discharge pipe, 11.70 feet above land-surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1941		1943		1943	
Apr. 27	[b]151	May 10	[b]91	July 19	88.76
Sept. 24	[b]152	28	87.15	26	91.11
November	[b]151	June 7	83.15	Aug. 4	89.01
1942		15	89.06	11	89.71
June	[b]141	22	90.90	18	91.28
November	[b]123	28	94.80	25	87.48
1943		July 6	92.24	Sept. 1	90.00
January	[b]83	12	92.91	8	87.26

[b]*Water level reported.*

Daily highest and lowest water levels, in feet below land-surface datum (From recorder charts)

Date	Depth to water Low	High	Date	Depth to water Low	High	Date	Depth to water Low	High
1943			1943			1943		
Oct. 6	105.59	103.96	Oct. 30	99.69	99.39	Nov. 13	103.48	102.17
7	105.68	103.70	31	99.79	95.00	14	103.02	102.65
8	104.47	103.02	Nov. 1	99.48	99.02	15	102.75	102.25
9	104.25	101.14	2	99.18	98.58	16	102.88	102.30
11	100.73	99.34	3	101.25	98.62	17	103.18	102.62
12	100.75	99.62	4	99.47	99.00	18	102.92	102.62
13	100.73	99.45	5	102.24	98.90	19	110.80	102.72
14	101.20	99.15	6	99.17	98.90	20	108.29	103.08
24	100.35	100.03	7	99.15	98.86	22	103.93	......
25	100.12	99.68	8	100.30	98.73	23	104.25	103.83
26	99.98	99.68	9	101.15	100.15	24	104.25	104.00
27	99.85	99.05	10	101.20	100.82	25	104.10	103.91
28	99.28	98.96	11	102.02	100.81	Dec. 3	108.63	102.72
29	100.81	99.27	12	102.70	101.84	4	103.57	102.96

TABLE 17—*Continued*

Bal-Gf 6. Bethlehem Steel Co.'s well, Wire Mill 8—*Continued*

Date	Depth to water Low	High	Date	Depth to water Low	High	Date	Depth to water Low	High
1943			1944			1944		
Dec. 5	103.24	102.88	Feb. 6	93.73	93.22	Feb. 29	93.14	92.67
6	103.35	102.97	15	94.55	93.90	30	92.85	92.58
7	103.30	102.97	20	94.70	94.30	31	92.84	92.47
8	103.35	103.03	23	94.43	94.07	Apr. 1	92.60	92.10
9	103.90	103.03	24	94.49	94.06	2	92.62	92.14
10	103.67	103.37	25	94.56	94.10	3	92.62	92.25
11	104.32	103.65	26	94.27	93.73	4	92.32	91.80
12	104.27	103.80	27	94.00	88.06	5	92.68	91.87
13	......	104.14	28	93.75	93.60	6	92.68	92.18
16	106.25	106.03	29	94.10	93.65	7	92.55	91.90
17	106.28	97.27	Mar. 1	94.44	94.08	8	92.27	91.22
18	97.27	96.80	2	94.50	94.05	9	91.42	90.64
19	96.80	96.24	3	95.87	93.82	10	90.71	90.15
20	96.56	96.19	4	95.93	95.74	11	90.63	90.04
21	96.50	95.85	6	96.15	96.02	12	90.06	89.52
22	96.60	95.95	7	96.38	95.83	13	90.72	89.92
23	97.31	96.42	8	96.40	95.67	14	90.07	88.45
30	95.80	95.52	9	95.87	95.44	15	88.45	87.29
31	95.77	95.53	10	95.55	94.85	16	87.29	86.70
1944			11	94.95	94.15	17	86.85	86.58
Jan. 1	95.98	95.65	12	94.27	93.87	21	86.22	85.74
2	95.82	95.57	13	95.00	93.82	22	87.29	86.11
6	96.10	94.80	14	95.61	95.00	23	87.52	87.05
11	95.05	94.70	15	95.65	95.42	24	87.67	86.94
12	95.23	94.82	16	95.68	94.00	25	87.21	86.75
13	95.50	95.23	17	94.60	93.85	26	87.23	86.82
14	102.81	95.32	18	94.25	93.77	27	87.22	86.78
15	96.07	95.18	19	94.67	93.82	28	87.28	87.00
16	95.32	94.86	20	94.31	93.80	29	87.20	86.56
17	94.97	94.82	21	94.62	94.20	30	86.56	86.22
18	95.06	93.85	22	94.70	94.27	May 1	89.05	85.67
19	94.89	94.47	23	94.60	93.89	2	90.56	89.05
20	94.62	94.25	24	94.47	94.00	3	90.87	88.18
21	95.12	94.60	25	94.56	94.07	4	88.18	87.65
22	94.95	94.72	26	94.56	93.75	5	88.65	85.45
23	95.01	94.63	27	93.75	93.10	6	85.45	84.39
Feb. 1	94.17	93.05	28	93.49	92.96	7	84.39	83.84

TABLE 17—*Continued*

Bal-Gf 6. Bethlehem Steel Co.'s well, Wire Mill 8—*Continued*

Date	Depth to water Low	High	Date	Depth to water Low	High	Date	Depth to water Low	High
1944			1944			1944		
May 8	84.80	83.71	July 3	93.51	93.13	Aug. 15	91.62	89.57
9	86.15	84.80	4	93.42	93.05	16	90.50	89.48
10	86.80	86.15	5	93.40	92.97	17	90.33	89.21
11	87.24	86.74	6	93.36	92.78	18	90.32	89.14
12	87.49	86.99	7	93.41	92.57	19	90.36	89.69
13	87.42	87.03	8	93.04	92.49	20	90.37	88.88
14	87.36	86.96	9	93.05	92.17	21	89.87	88.42
15	87.35	86.77	10	94.18	92.18	22	89.76	89.24
16	86.97	86.58	11	94.88	93.48	25	90.04	88.92
17	86.90	86.55	12	94.55	93.19	Sept. 1	89.62	89.17
18	86.80	86.38	13	96.46	93.47	2	89.51	88.75
19	87.36	86.67	14	97.85	96.13	3	90.32	89.45
20	87.18	86.45	15	97.82	96.78	4	90.51	89.10
21	87.18	86.64	16	97.72	.....	5	90.93	91.30
22	86.83	86.32	17	97.23	91.45	8	92.93	92.22
23	87.17	86.27	18	97.48	95.97	9	92.93	92.18
24	87.30	86.13	19	96.35	94.76	10	92.72	90.60
25	88.57	87.24	20	96.55	94.62	11	91.76	90.43
26	88.87	87.56	21	98.07	96.55	12	92.35	91.03
27	88.47	87.78	22	98.65	97.48	13	92.34	91.43
June 3	88.47	86.74	23	98.75	97.91	14	92.55	91.63
4	87.85	85.97	24	98.35	97.34	15	92.48	91.52
5	86.91	85.55	25	98.27	98.72	16	93.09	91.62
6	86.65	85.55	26	98.91	97.55	17	93.00	90.72
7	86.57	85.16	27	98.71	97.13	18	90.91	89.90
8	86.64	85.48	28	98.71	97.27	19	91.75	90.40
9	85.50	84.92	29	99.17	98.24	20	90.60	90.70
10	85.91	84.73	30	99.59	98.88	21	90.35	89,66
18	86.90	83.20	31	99.69	98.90	22	95.34	89.93
19	83.97	82.48	Aug. 1	100.27	98.92	23	91.20	90.19
20	83.76	82.24	2	100.27	99.80	24	90.77	89.35
21	83.54	82.41	3	100.27	89.06	25	90.14	88.59
22	83.65	81.99	4	100.09	98.92	26	90.36	90.02
23	83.30	82.18	11	99.14	98.67	27	90.36	89.38
30	93.62	93.22	12	90.29	89.37	28	89.53	89.14
July 1	93.63	93.41	13	89.63	89.12	29	89.53	88.94
2	93.62	93.23	14	90.32	89.02	30	89.67	88.97

TABLE 17--*Continued*

Bal-Gf 6. Bethlehem Steel Co.'s well, Wire Mill 8-*Continued*

Date	Depth to water Low	Depth to water High	Date	Depth to water Low	Depth to water High	Date	Depth to water Low	Depth to water High
1944			1944			1944		
Oct. 1	89.30	87.20	Oct. 18	91.56	89.56	Nov. 9	89.51	87.89
2	88.24	87.18	19	90.18	88.97	10	89.37	88.36
3	88.30	87.73	20	90.16	88.97	11	89.54	88.41
4	88.33	87.77	24	89.55	87.87	12	89.52	88.58
5	88.67	86.93	25	88.92	87.83	13	89.80	88.33
6	89.65	87.53	26	88.66	87.46	14	90.17	88.96
7	89.07	88.20	29	89.22	88.23	15	91.13	90.17
8	88.50	87.31	30	88.57	87.78	16	90.63	89.66
9	87.88	86.78	31	89.08	88.14	17	91.15	90.18
10	88.72	87.67	Nov. 1	89.55	87.74	18	91.18	90.49
11	89.80	88.61	2	88.31	87.10	21	91.05	89.47
12	89.69	88.65	3	88.85	87.65	22	91.03	89.90
13	91.88	89.04	4	89.65	88.63	23	90.08	88.95
14	91.94	89.53	5	89.74	88.48	24	89.40	89.63
15	90.78	90.11	6	89.10	88.47	25	89.67	88.63
16	92.56	89.62	7	89.26	88.18	30	89.67	88.83
17	93.77	90.36	8	89.05	87.95			

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1945		1945		1945	
Sept. 7	98.66	Oct. 16	88.46	Nov. 23	93.70
14	94.45	26	84.03	30	93.79
21	98.06	Nov. 2	84.16	Dec. 7	94.15
28	96.33	9	83.77	17	94.84
Oct. 5	96.22	16	83.69	21	95.51
				28	95.89

TABLE 17 — *Continued*

Bal-Gf 8. Bethlehem Steel Co.'s well, Wire Mill 10, Sparrows Point. Used drilled industrial well, diameter 12 to 7 inches, depth 618 feet. Measuring point, top of air line, 2.00 feet above land-surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1937		1943		1943	
--------	[b]94	January	[b]88	Aug. 4	[a]123
1939		April	[b]78	Sept. 8	[a]121
March	[b]118	9	[b]113	Oct. 7	[a]136
December	[b]141	May 10	[b]80	Nov. 4	[a]131
1940		21	[a]123	Dec. 9	[a]135
December	[b]135	28	[a]121	1944	
1941		June 7	[a]117	Jan. 8	[a]130
Apr. 27	[b]133	15	[a]123	Feb. 5	[a]127
Sept. 24	[b]145.85	22	[a]124	1945	
1942		28	[a]128	June 4	[a]82
June	[b]128	July 6	[a]127	4	[a,b]133
December	[b]121	12	[a]128	Oct. 16	[a]128
		19	[a]126		

[a]*Well pumping at time of measurement.*
[b]*Water level reported.*

Bal-Gf 9. Bethlehem Steel Co.'s well, Wire Mill 11, Sparrows Point. Used drilled industrial well, diameter 12 to 4½ inches, depth 456 feet. Measuring point, top of air line, 2.00 feet above land-surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1939		1941		1943	
March	[b]111	Sept. 24	[b]124	June 15	[a]187
October	[b]100	1943		22	[a]188
December	[b]123	Apr. 9	[a]188	28	[a]201
1940		May 10	[a,b]210	July 6	[a]203
December	[b]133	21	[a]189	12	[a]204
1941		28	[a]190	19	[a]211
Apr. 27	[b]147	June 7	[a]184	Aug. 4	[a]203

TABLE 17 – *Continued*

Bal-Gf 9. Bethlehem Steel Co.'s well, Wire Mill 11 – *Continued*

Date	Depth to water	Date	Depth to water	Date	Depth to water
1943		1944		1944	
Sept. 8	[a]201	Jan. 8	[a]211	June 13	[a]210
Oct. 7	[a]211	Feb. 5	[a]207	July 13	[a]219
Nov. 4	[a]210	Mar. 11	[a]211	1945	
Dec. 9	[a]211	Apr. 15	[a]209	June 4	[b]74
		21	[a]208	4	[a, b]203
		May 9	[a]208	Oct. 16	[a]202

[a] *Well pumping at time of measurement.*
[b] *Water level reported.*

Bal-Gf 12. Bethlehem Steel Co.'s well, Tin Mill 1, Sparrows Point. Used drilled industrial well, diameter 16 to 4½ inches, depth 677 feet. Measuring point, top of air line, 12.20 feet above land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1936		1943		1943	
--------	[b]59	January	[b]109	Aug. 4	87
1939		May 12	[b]85	11	87
March	[b]128	14	83	16	87
1940		28	82	26	84
January	[b]146	31	121	Sept. 1	84
October	[b]146	June 7	82	7	84
1941		15	89	Oct. 8	93
Apr. 27	[b]148	22	90	Nov. 3	107
Sept. 30	[b]128	28	93	Dec. 9	92
November	[b]145	July 6	92	1944	
1942		12	93	Jan. 8	89
July	[b]116	19	[a]146	Feb. 5	92
December	[b]113	26	88	1945	
				June 15	[b]83
				Oct. 15	77.82

[a] *Well pumping at time of measurement.*
[b] *Water level reported.*

TABLE 17—*Continued*

Bal-Gf 14. Bethlehem Steel Co.'s well, Tin Mill 2, Sparrows Point. Used drilled industrial well, diameter 12 to 4½ inches, depth 369 feet. Measuring point, top of air line, 3.00 feet above land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1939		1943		1943	
October	[b]162	May 12	[ab]133	Aug. 4	51
November	[b]187	14	75.62	Sept. 7	44
1941		21	53.70	Oct. 8	48
Apr. 27	[b]169	28	68.70	Nov. 3	46
Sept. 30	[b]140	June 7	71.82	Dec. 9	45
November	[b]142	15	59.64	1944	
1942		22	58.23	Jan. 8	50
December	[b]119	28	62.08	Feb. 5	48
1943		July 6	58.10	1945	
January	[b]87	12	58.75	June 15	[b]71
May 12	[b]52	19	60.02	Oct. 15	49.37

[a]*Well pumping at time of measurement*
[b]*Water level reported*

Bal-Gf 16. Bethlehem Steel Co.'s well, Tin Mill 3, Sparrows Point. Used drilled industrial well, diameter 16 to 6 inches, depth 659 feet. Measuring point, top of air line, 12.40 feet above land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1926		1943		1943	
June	[b]20	April	[b]85	July 12	89
1940		May 12	[b]82	19	98
January	[b]143	12	[a,b]158	Aug. 4	82
1941		14	79	Sept. 7	80
Apr. 27	[b]146	14	80.71	Oct. 8	91
June	[b]145	14	[a]158	Nov. 3	86
Sept. 30	[b]126	21	87	Dec. 9	90
November	[b]126	28	79	1944	
1942		June 7	76	Jan. 8	90
July	[b]126	15	82	Feb. 5	87
December	[b]118	22	88	1945	
1943		28	99	June 15	[b]76
January	[b]103	July 6	88	Oct. 15	77.85

[a]*Well pumping at time of measurement.*
[b]*Water level reported.*

TABLE 17 — *Continued*

Bal-Gf 18. Bethlehem Steel Co.'s well, Tin Mill 4, Sparrows Point. Used drilled industrial well, diameter 12 to 6 inches, depth 321 feet. Measuring point, top of discharge pipe, 10.50 feet above land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1939		1943		1943	
October	[b]156	May 14	71.76	Aug. 4	47.62
November	[b]179	14	76.85	11	45.47
1941		21	51.24	18	44.66
Apr. 27	[b]178	28	67.05	25	43.46
July	[b]179	June 7	70.54	Sept. 1	42.62
1942		15	57.56	7	42.05
July	[b]147	22	56.23	Oct. 8	44.53
November	[b]129	28	60.55	Dec. 9	41.11
1943		July 6	55.99	1944	
January	[b]97	12	57.15	Jan. 8	42.84
April	[b]75	19	58.36	Feb. 5	43.01
May 12	[b]49.52	26	51.97	1945	
				Oct. 15	46.76

[b]*Water level reported.*

Bal-Gf 25. Bethlehem Steel Co.'s well, Tin Mill 8, Sparrows Point. Unused drilled industrial well, diameter 16 to 4½ inches, depth 330 feet. Measuring point, top of discharge pipe, 10.50 feet above land surface. Well plugged in August 1943.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1940		1943		1943	
February	[b]179	May 12	[b]49.8	June 7	70.98
1941		14	71.75	15	58.03
Apr. 27	[b]174	14	77.46	22	56.49
Sept. 30	[b]147	21	51.46	28	60.81
November	[b]174	28	68.07	July 6	56.09
				12	57.17

[b]*Water level reported.*

TABLE 17 — *Continued*

Bal-Gf 27. Bethlehem Steel Co.'s well, Tin Mill 10, Sparrows Point. Used drilled industrial well, diameter 12 to 7 inches, depth 581 feet. Measuring point, top of air line, 1.0 foot above land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1940		1943		1943	
--------	[b]134	May 14	83.60	Aug. 4	84
1942		28	80	Sept. 7	80
July	[b]116	June 15	78	Oct. 8	89
August	[b]109	22	83	Dec. 9	86
1943		28	85	1944	
January	[b]91	July 6	98	Jan. 8	77
March	[b]91	12	86	Feb. 5	74
May 12	[b]83	19	84	1945	
				Oct. 15	64.23

[b]*Water level reported.*

Bal-Gf 28. Bethlehem Steel Co.'s well, Sheet Mill 1, Sparrows Point. Used drilled industrial well, diameter 16 to 6 inches, depth 177 feet. Measuring point, top of air line, 4.40 feet above land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1935		1942		1944	
--------	[b]33	December	[b]81	Jan. 8	27.92
1939		1943		Mar. 11	44.13
March	[b]51	January	[b]36	1945	
December	[b]86	July 19	32.15	June 15	[b]71
1940		Aug. 4	31.72	Oct. 15	25.58
November	[b]81	Sept. 7	32.16		
		Oct. 8	27.91		
		Nov. 3	26.47		

[b]*Water level reported.*

TABLE 17 – *Continued*

Bal-Gf 29. Bethlehem Steel Co.'s well, Sheet Mill 2, Sparrows Point. Used drilled industrial well, diameter 16 to 6 inches, depth 233 feet. Measuring point, top of air line, 4.00 feet above land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1935		1943		1944	
--------	[b]33	Aug. 4	31.71	Jan. 8	27.34
1943		Sept. 7	32.95	Mar. 11	[a]92.10
January	[b]54	Oct. 8	27.82	1945	
July 19	32.05	Nov. 3	25.45	Oct. 15	25.27
26	32.31				

[a]*Well pumping at time of measurement.*
[b]*Water level reported.*

Bal-Gf 30. Bethlehem Steel Co.'s well, Hot Strip 1, Sparrows Point. Used drilled industrial well, diameter 12 to 4½ inches, depth 247 feet. Measuring point, top of air line, 3.78 feet above land surface.

Water level, in feet above land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1937		1943		1943	
December	[b]70	January	[b]64	Dec. 10	24
1939		May	[b]32	1944	
December	[b]89	July 26	28	Jan. 8	23
1940		Aug. 4	27	Feb. 5	33
November	[b]84	11	25	Mar. 11	35
1941		18	26	Apr. 15	32
Apr. 26	[b]96	25	24	June 13	[a]121.47
October	[b]156	Sept. 1	24	July 13	42.34
1942		7	26	1945	
May	[b]151	Oct. 8	24	May 12	[b]38
December	[b]151	Nov. 3	24	Oct. 15	25.53
				Dec. 28	25.26

[a]*Well pumping at time of measurement.*
[b]*Water level reported.*

TABLE 17—*Continued*

Bal-Gf 31. Bethlehem Steel Co.'s well, Hot Strip 2, Sparrows Point. Used drilled industrial well, diameter 12 to 7 inches, depth 336 feet. Measuring point, top of air line, 3.35 feet above land surface.

Water level, in feet above land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1937		1942		1944	
November	[b]110	June	[b]151	Jan. 8	37.40
1939		November	[b]137	Feb. 5	43.15
March	[b]95	1943		Mar. 11	43.39
December	[b]168	January	[b]113	Apr. 15	[a]89.68
1940		Aug. 4	48.46	June 13	45.24
November	[b]128	Sept. 7	39.56	July 13	48.69
1941		Oct. 8	44.81	1945	
Apr. 26	[b]128	Nov. 3	42.83	Oct. 15	44.67
May	[b]135	Dec. 10	41.37		
September	[b]152				

[a]*Well pumping at time of measurement.*
[b]*Water level reported.*

Bal-Gf 32. Bethlehem Steel Co.'s well, Hot Strip 3, Sparrows Point. Used drilled industrial well, diameter 12 to 7 inches, depth 668 feet. Measuring point, top of air line, 4.00 feet above land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1937		1942		1943	
November	[b]10.3	May	[b]141	Nov. 3	[a]158
1939		November	[b]156	Dec. 10	[a]155
December	[b]131	1943		1944	
1940		January	[b]144	Jan. 8	[a]159
November	[b]134	May	[b]84	Feb. 5	[a]159
1941		Aug. 4	[a]155	1945	
Apr. 26	[b]136	Sept. 7	[a]153	May 12	[b]83
September	[b]172	Oct. 8	[a]158	Oct. 15	[a]118.14

[a]*Well pumping at time of measurement.*
[b]*Water level reported.*

TABLE 17--*Continued*

Bal-Gf 33. Betniehem Steel Co.'s well, Hot Strip 4, Sparrows Point. Unused drilled industrial well, diameter 12 to 7 inches, depth 330 feet. Measuring point, top of air line, 3.00 feet above land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1937		1941		1943	
June	[b]76	April	[b]187	Oct. 8	43.69
July	[b]88	1942		Nov. 3	42.36
1939		November	[b]197	Dec. 10	40.28
March	[b]152	1943		1944	
October	[b]196	January	[b]187	Jan. 8	41.74
1940		Aug. 4	45.02	1945	
--------	[b]193	Sept. 7	41.70	Oct. 15	43.85

[b]*Water level reported.*

Bal-Gf 34. Bethlehem Steel Co.'s well, Hot Strip 5, Sparrows Point. Unused drilled industrial well, diameter 12 to 8 inches, depth 233 feet. Measuring point, top of air line, 4.00 feet above land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1937		1942		1943	
July	[b]62	May	[b]97	Dec. 10	25
1939		November	[b]97	1944	
October	[b]88	1943		Jan. 8	25
1940		January	[b]97	Feb. 5	37
November	[b]92	May	[b]34	Mar. 11	38
November	[b]94	Aug. 4	28	1945	
1941		Sept. 7	31	May 12	[b]50
Apr. 26	[b]99	Oct. 8	26	Oct. 12	25.37
September	[b]106	Nov. 3	25		

[b]*Water level reported.*

TABLE 17 – *Continued*

Bal-Gf 35. Bethlehem Steel Co.'s well, Hot Strip 6, Sparrows Point. Used drilled industrial well, diameter 12 to 6 inches, depth 680 feet. Measuring point, top of air line, 3.50 feet above land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1937		1941		1943	
July	[b]86	Apr. 26	[b]144	January	[b]146
November	[b]116	October	[b]156	May	[b]105
1939		November	[b]166	1945	
September	[b]141	1942		May 12	[b]126
December	[b]139	May	[b]167	Oct. 12	[a]124.72
1940		November	[b]168		
December	[b]141				

[a]*Well pumping at time of measurement.*
[b]*Water level reported.*

Bal-Gf 36. Bethlehem Steel Co.'s well, Hot Strip 7, Sparrows Point. Unused drilled industrial well, diameter 12 to 7 inches, depth 685 feet. Measuring point, top of air line, 4.00 feet above land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1937		1941		1944	
October	[b]104	April	[b]191	Feb. 5	99
1939		1943		Mar. 11	99
October	[b]104	Oct. 8	[a]145	Apr. 15	86
1940		Nov. 3	97	1945	
--------	[b]130	1944		May 12	[b]33
November	[b]158	Jan. 8	101	Oct. 12	83.25

[a]*Well pumping at time of measurement.*
[b]*Water level reported.*

TABLE 17– *Continued*

Bal-Gf 37. Bethlehem Steel Co.'s well, Hot Strip 8, Sparrows Point. Used drilled industrial well, diameter 12 to 10 inches, depth 234 feet. Measuring point, top of air line, 3.00 feet above land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1937		1942		1943	
May	[b]59	May	[b]125	Dec. 10	26
November	[b]67	November	[b]107	1944	
1939		1943		Jan. 8	27
November	[b]82	January	[b]105	Feb. 5	35
1940		May	[b]35	Mar. 11	39
November	[b]86	Aug. 4	29	1945	
1941		11	41	May 12	[b]26
Apr. 26	[b]86	Sept. 7	[a]145	Oct. 15	24.47
May	[b]92	Oct. 8	26		
September	[b]112	Nov. 3	26		

[a]*Well pumping at time of measurement.*
[b]*Water level reported.*

Bal-Gf 38. Bethlehem Steel Co.'s well, Hot Strip 9, Sparrows Point. Used drilled industrial well, diameter 12 to 7 inches, depth 355 feet. Measuring point, top of air line, 3.00 feet above land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1937		1941		1943	
November	[b]78	Apr. 26	[b]169	Aug. 25	37
1938		October	[b]189	Sept. 1	37
April	[b]72	1942		7	37
May	[b]82	May	[b]162	Oct. 8	40
November	[b]72	November	[b]132	Nov. 3	38
1939		1943		Dec. 10	37
November	[b]190	January	[b]112	1944	
1940		May	[b]85	Jan. 8	39
February	[b]198	July 26	45	Feb. 5	39
November	[b]199	Aug. 4	42	1945	
		18	39	May 12	[b]61
				Oct. 15	44.10

[b]*Water level reported.*

TABLE 17 – *Continued*

Bal-Gf 46. Bethlehem Steel Co.'s well, Forty-inch Mill 1, Sparrows Point. Unused drilled industrial well, diameter 12 to 6 inches, depth 209 feet. Measuring point, top of discharge pipe, 9.40 feet above land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1939		1943		1943	
October	[b]141	January	[b]44	Oct. 7	29.33
1940		May	[b]35	Nov. 4	27.95
January	[b]158	July 26	35.87	Dec. 9	27.48
1941		Aug. 4	33.72	1944	
Apr. 27	[b]146	11	31.63	Jan. 8	28.02
September	[b]157	18	30.72	Feb. 5	30.89
1942		25	29.65	Mar. 11	34.42
June	[b]64	Sept. 1	29.12	1945	
November	[b]66	7	29.02	June 8	[b]31
				Oct. 16	26.82

[b]*Water level reported.*

Bal-Gf 47. Bethlehem Steel Co.'s well, Forty-inch Mill 2, Sparrows Point. Unused drilled industrial well, diameter 12 to 4½ inches, depth 418 feet. Measuring point, top of discharge pipe, 9.70 feet above land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1940		1943		1943	
January	[b]146	May	[b]82	Nov. 4	82.94
1941		July 26	83.76	Dec. 9	88.50
Apr. 27	[b]150	Aug. 4	84.53	1944	
September	[b]156	11	82.46	Jan. 8	90.91
1942		18	83.83	Feb. 5	89.22
June	[b]120	25	81.03	1945	
November	[b]116	Sept. 1	80.24	June 8	[b]77.8
1943		7	80.00	Oct. 16	77.83
January	[b]103	Oct. 7	89.53		

[b]*Water level reported.*

TABLE 17 – *Continued*

Bal-Gf 48. Bethlehem Steel Co.'s well, Forty-inch Mill 3, Sparrows Point. Unused drilled industrial well, diameter 12 to 4½ inches, depth 421 feet. Measuring point, top of discharge pipe, 9.35 feet above land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1940		1943		1944	
January	[b]130	January	[b]94	Feb. 5	80.38
1941		May	[b]93	Mar. 11	80.45
Apr. 27	[b]136	Aug. 4	80.37	Apr. 21	72.77
September	[b]122	Sept. 7	80.10	May 9	72.93
October	[b]157	Oct. 7	88.31	June 13	71.79
1942		Dec. 9	82.06	July 13	76.42
June	[b]117	1944		1945	
November	[b]116	Jan. 8	83.55	Oct. 16	76.09

[b]*Water level reported.*

Bal-Gf 50. Bethlehem Steel Co.'s well, Forty-inch Mill 5, Sparrows Point. Unused drilled industrial well, diameter 12 to 5 inches, depth 286 feet. Measuring point, top of discharge pipe, 9.60 feet above land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1940		1941		1942	
January	[b]61	September	[b]68	November	[b]123
May	[b]67	October	[b]128	1943	
1941		1942		January	[b]79
Apr. 27	[b]67	June	[b]113	May	[b]57

[b]*Water level reported.*

TABLE 17—*Continued*

Bal-Gf 50. Bethlehem Steel Co.'s well, Forty-inch Mill 5—*Continued*

Daily highest and lowest water levels, in feet below land-surface datum
(From recorder charts)

Date	Depth to water Low	High	Date	Depth to water Low	High	Date	Depth to water Low	High
1943			1943			1943		
July 17	66.80	66.36	Aug. 26	50.34	49.75	Sept. 28	52.40	51.84
18	66.73	65.63	27	50.34	49.83	29	52.33	51.89
19	65.77	65.59	28	49.94	49.62	30	52.00	51.83
20	66.07	65.42	29	49.94	48.34	Oct. 1	52.03	51.00
21	66.75	64.75	30	50.30	48.75	2	51.95	50.62
22	64.75	63.35	31	49.75	49.35	3	55.17	51.95
23	63.30	62.80	Sept. 1	50.04	49.07	4	56.12	52.92
24	63.17	62.37	2	49.82	49.33	5	53.95	52.25
25	62.45	62.12	3	49.45	49.13	6	52.30	51.95
26	64.37	62.02	4	49.17	48.91	7	52.03	51.44
27	65.41	62.67	5	48.97	46.90	8	52.00	51.34
28	63.75	62.67	6	49.64	48.05	9	51.95	51.07
29	62.90	62.20	7	49.47	48.95	10	51.35	50.90
30	63.20	62.23	8	51.07	48.66	11	51.35	50.63
31	63.42	61.65	9	50.23	49.40	12	51.27	50.58
Aug. 1	62.97	61.77	10	50.28	49.37	13	51.10	50.58
2	61.87	59.68	11	50.23	49.57	14	55.69	50.85
5	54.76	54.08	12	50.07	49.31	15	58.23	53.20
6	54.55	53.70	13	51.87	49.32	16	55.25	51.77
7	53.78	52.77	14	50.72	49.99	17	51.77	51.25
8	53.45	52.45	15	50.55	50.07	18	55.83	51.15
9	52.45	52.17	16	57.48	50.08	19	53.70	52.20
10	52.25	51.92	17	61.65	57.48	20	52.25	51.10
12	52.27	51.82	18	62.81	57.05	21	51.10	50.40
13	52.27	51.50	19	57.05	53.15	22	50.45	50.19
14	51.60	50.90	20	59.40	52.53	23	50.40	49.97
17	50.98	50.54	21	62.29	59.40	24	50.10	49.75
18	51.48	51.07	22	63.55	62.29	25	49.92	49.52
19	51.14	50.78	23	63.52	57.16	26	49.75	49.37
20	51.09	50.68	24	57.16	54.23	27	49.37	48.90
21	51.00	50.58	25	54.23	52.68	28	49.18	48.47
22	51.26	50.60	26	54.77	53.10	29	49.78	49.05
25	50.00	49.72	27	53.10	52.15	30	49.97	49.45

TABLE 17—*Continued*

Bal-Gf 50. Bethlehem Steel Co.'s well, Forty-inch Mill 5—*Continued*

Date	Depth to water Low	High	Date	Depth to water Low	High	Date	Depth to water Low	High
1943			1943			1944		
Oct. 31	49.90	48.77	Dec. 9	48.60	48.22	Feb. 8	51.37	50.58
Nov. 1	48.77	47.82	10	48.58	48.20	9	51.36	50.70
2	51.45	47.27	11	49.11	48.23	10	52.16	51.18
3	49.83	48.12	16	50.38	49.95	11	51.78	51.18
4	48.12	47.65	17	50.54	49.87	12	51.90	51.20
5	47.70	46.92	1944			14	52.47	52.20
6	46.88	46.61	Jan. 7	50.23	49.85	15	52.94	51.97
7	46.95	46.70	8	49.90	49.70	16	52.94	51.83
8	47.06	46.53	9	50.25	49.80	17	52.50	52.11
9	46.62	46.11	10	50.00	49.80	18	52.57	52.21
10	46.70	46.45	11	50.02	50.31	19	53.01	52.47
12	46.91	46.40	12	50.65	50.05	20	52.95	52.17
12	46.95	46.00	13	50.88	50.45	21	52.52	51.95
13	46.45	45.79	14	54.15	50.60	22	52.50	52.27
14	46.40	46.00	15	52.90	50.90	23	52.30	51.40
15	46.00	45.50	16	50.90	49.80	24	52.33	51.75
16	46.34	45.30	17	50.07	49.60	25	52.36	51.71
18	46.50	45.85	18	50.25	50.00	26	51.97	51.57
19	47.63	46.43	19	50.45	50.04	27	51.86	51.48
20	48.35	47.60	20	50.15	49.78	28	51.82	51.56
21	48.25	47.52	21	50.02	49.80	29	52.08	51.27
22	48.87	47.45	22	49.94	49.67	Mar. 1	52.75	52.00
23	49.03	48.36	23	49.81	49.50	2	53.75	52.49
26	48.83	48.23	24	50.18	49.56	3	56.10	51.93
27	48.61	48.02	25	50.12	49.75	4	55.40	53.00
28	48.74	48.37	26	50.15	49.61	6	53.00	52.95
29	48.92	48.37	27	49.95	49.30	7	53.02	52.61
30	50.08	48.66	28	49.55	49.02	8	52.88	52.54
Dec. 1	51.53	50.08	29	49.53	48.96	9	54.11	52.88
2	51.82	50.25	Feb. 1	50.18	48.72	10	55.10	53.78
3	50.25	49.57	2	50.20	49.95	11	55.16	54.05
4	49.65	48.70	3	49.93	49.55	12	54.05	53.20
5	48.95	48.38	4	50.38	49.68	13	53.38	52.96
6	48.57	48.35	5	50.49	50.10	14	53.60	53.12
7	48.78	48.26	6	50.70	49.91	15	53.25	52.35
8	48.79	48.22	7	50.81	50.41	16	52.40	52.07

TABLE 17—*Continued*

Bal-Gf 50. Bethlehem Steel Co.'s well, Forty-inch Mill 5—*Continued*

Date	Depth to water Low	Depth to water High	Date	Depth to water Low	Depth to water High	Date	Depth to water Low	Depth to water High
1944			1944			1944		
Mar. 17	52.87	51.97	Apr. 26	51.87	51.35	June 4	55.29	53.21
18	52.77	52.44	27	51.77	51.31	5	53.23	52.63
19	52.68	52.18	28	51.75	51.43	6	53.17	52.56
20	52.18	51.76	29	51.45	51.15	7	53.75	52.69
22	52.67	52.00	30	51.15	50.65	8	53.88	53.48
23	52.61	52.12	May 1	51.47	50.47	9	53.61	52.96
24	52.52	51.90	2	52.35	51.42	10	53.38	52.85
25	52.65	52.10	3	53.80	51.95	11	54.01	53.12
26	52.42	51.82	6	83.43	81.85	12	54.24	53.55
27	52.23	51.65	7	81.85	89.39	13	54.40	53.35
28	52.87	52.12	8	81.55	80.84	14	54.34	53.67
29	52.70	52.03	9	82.05	81.55	15	54.12	53.57
30	52.23	51.81	10	82.50	81.93	16	54.55	53.41
31	52.24	51.95	11	82.82	82.37	17	55.04	53.77
Apr. 1	52.05	51.44	12	83.67	77.50	18	55.45	53.85
2	51.55	51.38	13	77.50	65.90	19	57.82	53.52
3	51.93	51.55	14	65.90	60.65	20	57.44	54.88
4	51.80	51.33	15	60.65	58.21	21	57.84	55.08
5	52.22	51.43	16	58.21	57.00	22	56.76	54.98
6	52.53	52.08	17	57.00	56.10	23	57.45	54.87
7	52.92	51.74	18	56.10	55.29	24	59.86	54.61
8	52.45	51.97	19	55.29	54.80	25	59.00	55.44
9	52.08	51.42	20	54.80	54.07	26	55.44	54.58
10	51.75	50.92	21	54.38	53.67	27	55.17	54.63
11	51.82	51.27	22	53.67	53.25	28	55.18	54.61
12	52.30	50.68	23	53.90	53.38	29	55.55	54.66
15	61.20	60.14	24	53.75	53.20	30	56.17	54.82
16	62.46	61.20	25	53.71	53.20	July 1	56.12	55.27
17	64.01	62.46	26	53.84	53.32	2	55.60	54.57
18	64.12	58.65	27	53.59	53.15	3	55.10	54.36
19	58.65	54.27	28	53.48	53.15	4	55.02	54.48
20	54.27	53.12	29	53.70	53.33	5	56.07	54.51
21	54.17	53.12	30	58.77	53.70	6	57.15	55.50
22	53.63	52.60	31	58.75	54.79	7	57.12	56.40
23	52.60	51.73	June 1	58.00	54.82	8	56.86	53.87
24	52.52	51.94	2	57.67	54.52	9	55.91	51.77
25	52.45	51.80	3	56.06	54.32	14	56.21	55.68

TABLE 17—*Continued*

Bal-Gf 50. Bethlehem Steel Co.'s well, Forty-inch Mill 5—*Continued*

Date	Depth to water Low	High	Date	Depth to water Low	High	Date	Depth to Low	High
1944			1944			1944		
July 15	56.05	55.26	Aug. 22	56.04	53.25	Oct. 6	47.53	47.06
16	55.94	54.43	23	54.72	54.17	7	47.80	47.38
17	54.76	54.14	24	54.40	53.88	8	47.87	47.58
18	54.74	54.12	25	54.34	53.90	9	48.51	47.48
19	54.12	53.45	26	55.94	52.68	10	49.95	48.51
20	53.43	53.11	27	53.89	53.36	11	50.16	49.83
21	53.30	52.81	28	53.45	52.75	12	50.29	49.90
22	52.96	52.51	29	53.27	52.45	13	50.30	49.76
23	52.51	51.95	30	56.72	52.69	14	49.93	49.45
24	54.07	51.75	31	57.45	54.12	15	50.31	49.65
25	55.31	52.74	Sept. 1	58.11	56.27	16	50.33	50.11
26	56.69	52.97	11	57.36	53.22	17	50.65	50.15
27	55.91	53.53	12	55.33	52.75	18	50.37	49.56
28	56.90	53.30	13	54.00	52.01	19	49.60	47.53
29	57.08	53.69	14	54.14	52.91	20	49.53	48.60
30	56.35	53.65	15	53.89	52.39	21	48.96	48.45
31	53.74	53.25	16	54.57	53.09	22	48.99	48.64
Aug. 1	53.69	53.23	17	53.09	52.28	23	48.98	48.52
2	53.53	52.74	18	58.60	52.65	24	49.12	48.56
4	53.26	53.09	19	56.60	53.07	25	48.97	48.40
5	53.33	52.95	20	53.07	52.19	26	51.20	48.18
6	53.42	52.69	21	52.23	51.58	27	50.25	49.32
7	53.90	52.67	22	53.99	51.65	28	49.55	49.32
8	53.90	53.15	23	52.62	52.10	29	49.32	48.45
9	53.90	52.95	24	52.10	51.20	30	51.69	48.32
11	58.63	55.12	25	51.48	51.05	31	50.85	49.77
12	58.22	55.07	26	51.33	50.93	Nov. 1	51.72	49.35
13	57.00	54.90	27	51.20	50.30	2	51.26	50.58
14	54.45	54.42	28	50.30	49.16	3	50.58	49.80
15	54.76	54.27	29	49.46	48.88	4	49.80	49.00
16	54.45	54.10	30	49.54	48.78	5	49.50	49.06
17	55.88	53.50	Oct. 1	48.78	47.04	6	52.65	49.42
18	55.52	54.37	2	48.15	47.42	7	55.30	52.65
19	54.43	53.97	3	48.22	47.90	9	55.98	53.99
20	54.00	53.28	4	48.00	47.58	10	56.25	51.93
21	53.51	53.22	5	47.76	47.24	11	58.50	53.55

TABLE 17—*Continued*

Bal-Gf 50. Bethlehem Steel Co.'s well, Forty-inch Mill 5—*Continued*

Date	Depth to water		Date	Depth to water		Date	Depth to water	
	Low	High		Low	High		Low	High
1944			1944			9145		
Nov. 12	58.79	51.65	Dec. 26	47.76	46.48	Jan. 30	49.06	48.61
13	53.87	50.98	27	47.71	47.31	31	49.67	48.70
14	53.87	50.74	28	48.15	47.25	Feb. 1	49.80	49.62
15	56.15	50.03	29	48.50	47.84	2	50.10	49.55
16	54.03	50.70	30	47.88	47.20	3	50.30	49.96
17	50.70	50.00	31	47.25	46.56	4	49.96	48.05
18	50.23	49.15	1945			5	48.93	47.88
19	49.15	48.65	Jan. 1	46.56	46.18	6	48.95	48.53
20	48.77	48.37	2	47.78	46.26	7	48.95	48.67
21	49.23	48.32	3	47.95	47.55	8	48.72	48.22
22	52.97	48.74	4	47.75	47.40	15	48.19	47.48
23	50.75	49.08	5	47.91	47.16	16	48.42	47.43
24	49.62	48.42	6	47.78	46.90	17	48.19	47.68
25	48.76	48.24	7	47.12	46.23	18	47.90	47.54
26	48.49	47.82	8	49.42	46.40	19	48.62	47.90
27	47.87	47.36	9	48.35	47.56	20	48.65	48.35
28	48.05	47.37	10	48.55	48.29	22	48.34	48.19
29	47.99	47.45	11	48.35	47.93	23	45.89	48.25
30	48.17	47.62	12	48.25	47.56	24	45.70	50.31
Dec. 1	48.42	47.80	13	47.56	47.10	25	50.31	49.48
2	48.36	47.98	14	47.43	46.63	26	49.48	48.70
3	48.58	48.17	15	47.58	46.70	27	48.99	48.19
4	48.46	47.80	16	47.75	46.82	28	48.94	48.53
5	47.98	47.53	17	48.22	47.63	Mar. 1	49.05	48.42
14	48.32	48.05	18	48.34	47.90	2	48.63	48.29
15	48.68	47.89	19	47.97	47.37	3	48.34	47.82
16	47.89	47.32	20	47.37	46.67	4	48.12	47.88
17	47.53	46.68	21	47.38	44.33	5	48.31	47.81
18	47.86	46.65	22	45.89	44.19	6	48.19	47.75
19	48.38	47.33	23	46.91	45.77	7	48.74	48.19
20	48.02	47.59	24	48.15	45.80	8	48.80	48.54
21	48.60	47.59	25	48.86	48.15	9	48.89	48.62
22	48.60	48.28	26	49.07	48.57	10	48.85	48.45
23	48.50	47.36	27	48.63	48.27	11	48.61	48.20
24	47.40	46.91	28	48.81	48.27	12	48.31	47.90
25	47.17	46.28	29	48.80	48.28	13	48.44	47.85

TABLE 17—*Continued*

Bal-Gf 50. Bethlehem Steel Co.'s well, Forty-inch Mill 5—*Continued*

Date	Depth to water Low	Depth to water High	Date	Depth to water Low	Depth to water High	Date	Depth to water Low	Depth to water High
1945			1945			1945		
Mar. 14	48.29	47.86	Apr. 20	49.18	48.30	May 28	55.21	49.42
15	48.31	47.86	21	48.35	47.96	29	56.13	50.56
16	51.00	47.60	22	49.28	47.84	30	60.52	52.30
17	50.00	48.60	23	49.35	48.44	31	60.52	52.85
18	48.60	48.27	24	48.44	47.72	June 1	52.89	50.48
19	48.20	47.85	25	48.10	47.57	2	50.48	49.23
20	48.25	47.80	26	48.10	47.80	3	49.28	48.22
21	48.09	47.63	27	51.98	47.87	4	48.68	48.01
22	48.25	47.58	28	50.65	48.65	5	51.35	48.24
23	48.27	47.79	29	48.65	47.95	6	50.27	48.83
24	47.98	47.57	30	54.62	47.87	7	49.55	48.88
25	47.90	47.48	May 1	57.01	52.85	8	49.85	49.24
26	53.00	47.29	2	52.85	49.77	9	49.90	49.35
27	54.21	49.33	3	62.95	49.52	10	49.35	48.28
28	54.98	49.72	4	69.73	62.95	11	56.30	47.97
29	52.90	49.65	7	51.36	50.90	12	59.86	56.30
30	49.99	49.32	8	50.90	49.92	13	61.63	59.86
31	49.60	48.83	9	52.60	49.58	14	61.46	55.60
Apr. 1	49.07	48.45	10	51.60	49.55	15	55.60	52.42
2	48.68	48.25	11	51.91	49.36	16	52.42	50.43
3	48.83	48.34	12	50.92	49.28	17	51.39	50.33
4	48.64	48.22	13	51.35	48.30	18	52.32	50.40
6	50.25	49.44	14	50.30	48.88	19	51.16	50.20
7	50.06	49.47	15	48.88	48.23	20	51.63	50.92
8	49.90	49.21	16	48.48	48.23	21	51.87	51.31
9	55.15	48.93	17	48.29	48.10	22	52.25	51.56
10	53.90	50.08	18	48.10	47.78	23	51.73	50.23
11	50.08	49.35	19	48.73	48.00	24	50.23	48.37
12	49.36	48.96	20	48.72	47.73	25	48.37	47.69
13	49.25	48.91	21	47.73	47.28	26	47.79	47.13
14	49.00	48.43	22	47.54	47.08	27	47.46	46.62
15	49.02	48.37	23	49.20	47.40	28	47.00	46.16
16	48.66	48.13	24	49.35	47.98	29	48.96	47.00
17	48.67	48.24	25	48.58	47.85	July 3	55.28	53.00
18	49.44	48.57	26	53.92	47.42	4	53.00	50.49
19	49.55	49.12	27	55.94	50.77	5	57.37	49.58

TABLE 17—*Continued*

Bal-Gf 50. Bethlehem Steel Co.'s well, Forty-inch Mill 5—*Continued*

Date	Depth to water Low	Depth to water High	Date	Depth to water Low	Depth to water High	Date	Depth to water Low	Depth to water High
1945			1945			1945		
July 6	60.83	57.37	Aug. 12	57.58	52.00	Sept. 20	51.00	50.17
7	62.50	60.83	13	52.00	50.95	21	50.45	49.03
8	62.75	54.93	14	50.95	49.93	22	49.38	48.79
9	60.19	53.00	15	49.93	49.48	23	48.79	48.01
10	62.90	58.91	16	49.48	49.12	24	48.48	47.65
11	63.00	60.84	17	52.04	48.64	25	48.43	47.94
13	62.94	60.15	18	54.12	49.38	26	51.27	57.94
14	60.15	54.15	19	53.16	49.55	27	51.83	49.17
15	54.15	51.23	20	49.55	48.65	28	51.15	48.83
16	57.80	51.20	21	49.20	48.52	29	48.83	48.02
17	61.16	57.80	22	49.20	48.62	30	48.35	48.00
18	62.37	61.16	23	49.32	48.53	Oct. 1	48.10	47.04
19	62.95	62.24	24	48.94	48.39	2	47.55	46.81
20	63.44	62.75	25	48.71	47.97	3	48.34	47.55
21	63.47	63.05	26	48.65	47.96	4	48.79	47.80
22	63.62	57.87	27	48.58	47.78	5	48.69	47.60
23	57.87	53.40	28	51.51	47.75	6	47.79	47.06
24	53.40	51.83	29	51.07	48.68	7	47.60	46.90
25	55.35	50.74	30	53.11	49.79	8	48.01	46.62
26	59.05	55.35	31	54.90	50.08	9	48.07	46.70
27	60.62	57.67	Sept. 1	52.90	50.03	10	51.40	47.67
28	61.80	59.69	2	51.11	48.99	11	53.51	48.93
29	62.05	57.45	3	49.19	48.66	12	48.06	47.96
30	59.87	54.45	4	48.83	48.06	13	48.20	47.75
31	60.95	57.76	5	48.73	47.93	14	47.93	46.80
Aug. 1	61.78	58.57	6	48.63	47.82	15	50.63	46.89
2	62.17	59.12	7	48.46	47.94	16	49.90	47.61
3	62.57	59.85	8	48.26	47.79	17	53.15	47.46
4	62.85	60.05	9	48.24	47.35	18	57.20	53.15
5	62.90	55.43	10	47.62	47.35	19	56.15	48.25
6	57.83	54.13	11	50.15	47.33	20	54.52	50.09
7	59.77	54.17	12	51.65	48.78	21	51.62	48.29
8	61.30	59.42	13	52.13	48.17	22	48.29	47.31
9	61.51	56.54	14	54.04	48.67	23	47.36	46.88
10	56.54	52.70	15	52.80	51.15	24	51.35	46.85
11	53.85	51.16	18	51.15	48.27	25	51.35	48.10

TABLE 17 — *Continued*

Bal-Gf 50. Bethlehem Steel Co.'s well, Forty-inch Mill 5 — *Continued*

Date	Depth to water		Date	Depth to water		Date	Depth to water	
	Low	High		Low	High		Low	High
1945			1945			1945		
Oct. 26	47.28	47.19	Nov. 18	47.25	46.63	Dec. 9	46.14	45.70
27	47.95	47.43	19	46.64	46.20	10	46.55	45.63
28	49.19	47.24	20	46.88	46.09	11	46.72	46.39
29	48.26	47.64	21	46.90	46.45	12	47.13	46.66
30	47.85	47.30	22	49.74	45.79	13	47.66	47.05
Nov. 2	46.88	46.77	23	48.37	47.26	14	47.22	46.46
3	46.98	46.88	24	47.26	46.53	17	47.15	46.64
4	47.22	46.98	25	46.53	46.29	18	47.45	47.00
5	51.90	46.80	26	50.94	46.26	19	47.38	46.41
6	54.05	50.13	27	50.14	47.42	20	47.22	46.76
7	50.13	47.30	28	49.40	46.86	21	47.30	46.88
8	47.30	46.64	29	46.88	46.63	22	47.20	46.91
9	47.02	46.67	30	47.40	46.77	23	47.21	46.84
10	46.79	46.54	Dec. 1	47.42	46.93	24	47.10	46.78
11	46.63	46.48	2	46.93	45.72	25	46.83	44.75
12	46.61	46.22	3	45.72	45.10	26	45.73	45.20
13	46.55	46.06	4	46.43	45.60	28	46.98	46.84
14	50.14	45.92	5	46.46	46.09	29	46.85	46.50
15	52.65	47.90	6	46.97	45.97	30	46.54	45.63
16	53.17	48.92	7	46.61	46.16	31	46.03	45.58
17	49.29	47.25	8	46.25	46.03			

Bal-Gf 51. Bethlehem Steel Co.'s well, Forty-inch Mill 6, Sparrows Point. Unused drilled industrial well, diameter 12 to 8 inches, depth 419 feet. Measuring point, top of discharge pipe, 9.20 feet above land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1940		1942		1943	
January	[b]136	June	[b]113	May	[b]87
1941		November	[b]116	Aug. 4	84.85
Apr. 27	[b]148	1943		Sept. 7	80.35
September	[b]170	January	[b]92	Oct. 7	88.98

TABLE 17—*Continued*

Bal-Gf 51. Bethlehem Steel Co.'s well, Forty-inch Mill 6—*Continued*

Date	Depth to water	Date	Depth to water	Date	Depth to water
1943		1944		1945	
Nov. 4	83.51	Jan. 8	88.76	June 8	[b]78
Dec. 9	87.51			Oct. 16	76.26

[b]*Water level reported.*

Bal-Gf 52. Bethlehem Steel Co.'s well, Forty-inch Mill 7, Sparrows Point. Used drilled industrial well, diameter 12 to 6 inches, depth 655 feet. Measuring point, top of air line, 10.20 feet above land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1936		1943		1944	
--------	[b]60	May	[b]93	Jan. 8	91
1940		Aug. 4	89	Feb. 5	91
January	[b]138	11	89	Mar. 11	[a]144
October	[b]134	18	87	Apr. 21	82
1941		25	84	May 9	83
Apr. 27	[b]134	Sept. 1	84	June 13	80
September	[b]129	7	84	July 13	84
1942		Oct. 7	92	1945	
November	[b]115	Nov. 4	89	June 8	[b]81
1943		Dec. 9	91	Oct. 16	78.44
January	[b]101				

[a]*Well pumping at time of measurement.*
[b]*Water level reported.*

TABLE 17—*Continued*

Bal-Gf 53. Bethlehem Steel Co.'s well, Forty-inch Mill 8, Sparrows Point. Used drilled industrial well, diameter 12 to 6 inches, depth 667 feet. Measuring point, top of air line, 10.00 feet above land surface

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1936		1942		1943	
--------	[b]60	November	[b]120	Nov. 4	82
1940		1943		Dec. 9	88
January	[b]134	January	[b]98	1944	
October	[b]134	May	[b]80	Jan. 8	89
1941		Aug. 4	86	Feb. 5	85
Apr. 27	[b]162	Sept. 7	78	1945	
September	[b]130.5	Oct. 7	90	June 8	[b]79
				Oct. 16	78.86

[b]*Water level reported.*

Bal-Gf 78. Bethlehem Steel Co.'s well, Rail Mill 25, Sparrows Point. Used drilled industrial well, diameter 16 to 7 inches, depth 651 feet. Measuring point, top of air line, 3.7 feet above land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1939		1942		1943	
October	[b]125	June	[b]134	Dec. 9	[a]141
1940		1943		1944	
January	[b]121	Aug. 5	[a]135	Jan. 8	[a]140
1941		Sept. 7	[a]123	Feb. 5	[a]140
Apr. 26	[b]132	Oct. 7	[a]143	1945	
Sept. 27	[b]133	Nov. 4	[a]141	June 16	[b]69
				Nov. 5	[a]135.89

[a]*Well pumping at time of measurement.*
[b]*Water level reported.*

TABLE 17—*Continued*

Bal-Gf 79. Bethlehem Steel Co.'s well, Open Hearth 1, Sparrows Point. Unused drilled industrial well, diameter 12 to 6 inches, depth 208 feet. Measuring point, edge of iron platform on top of well box, 8.80 feet above land surface. Automatic water-stage recorder installed July 20, 1943. Reported water levels, in feet below land-surface datum: Apr. 26, 1941, 69; Sept. 27, 1941, 69; May 20, 1943, 37.92.

Daily highest and lowest water levels, in feet below land-surface datum
(From recorder charts)

Date	Depth to water Low	High	Date	Depth to water Low	High	Date	Depth to water Low	High
1943			1943			1943		
July 20	39.42	39.17	Aug. 21	33.88	33.67	Sept. 24	33.46	33.18
21	39.43	39.17	22	33.82	33.66	25	33.42	32.95
22	39.61	39.28	25	33.26	33.04	26	33.44	33.16
23	39.87	39.55	26	33.46	33.07	27	33.41	33.04
24	39.85	39.50	27	33.47	33.12	28	33.32	33.14
25	39.65	39.37	28	33.39	33.02	29	33.38	33.25
27	39.66	39.50	29	33.39	32.50	30	33.31	33.11
28	39.66	39.44	30	32.72	32.53	Oct. 1	33.45	32.61
29	39.71	39.42	31	32.72	32.60	3	33.49	33.34
30	39.95	39.40	Sept. 1	32.75	32.50	4	33.37	33.02
31	40.01	39.78	2	32.90	32.53	5	33.13	32.98
Aug. 1	39.95	39.56	3	32.96	.....	6	33.11	32.84
2	39.59	39.43	7	32.44	31.08	7	32.98	32.74
3	39.56	38.28	8	32.66	32.29	8	33.04	32.75
4	38.28	37.40	9	32.62	32.25	9	33.01	32.52
5	37.40	36.98	10	32.93	32.37	10	33.14	32.56
6	37.18	36.60	11	32.89	32.61	11	33.14	32.39
7	36.60	36.00	12	32.83	32.61	12	32.58	32.29
11	35.56	35.16	13	32.83	32.46	13	32.64	32.42
12	35.35	34.83	14	32.86	32.44	14	32.56	32.42
13	34.94	34.38	15	32.93	32.53	15	32.61	32.36
14	34.38	34.00	16	32.70	32.47	16	32.44	32.19
15	34.36	34.18	17	33.49	32.67	17	32.84	32.19
16	34.32	33.86	18	33.87	33.48	18	32.85	32.60
17	34.24	33.66	19	33.70	33.17	19	33.04	32.51
18	34.39	34.14	20	33.17	32.90	20	32.96	32.62
19	34.19	33.98	22	33.38	33.25	21	32.68	32.36
20	34.05	33.78	23	33.36	33.00	22	32.55	32.18

TABLE 17—*Continued*

Bal-Gf 79. Bethlehem Steel Co.'s well, Open Hearth 1—*Continued*

Date	Depth to water		Date	Depth to water		Date	Depth to water	
	Low	High		Low	High		Low	High
1943			1943			1944		
Oct. 23	32.60	32.40	Nov. 30	31.23	30.82	Jan. 4	31.40	30.31
24	32.56	32.26	Dec. 1	32.03	31.23	5	31.44	30.63
25	32.37	31.97	2	32.35	31.95	6	30.85	30.45
26	32.07	31.74	3	32.09	31.72	7	31.06	30.80
27	31.87	31.38	4	31.72	31.16	8	31.18	31.00
28	31.46	31.20	5	31.16	30.90	9	31.24	31.08
29	31.93	31.40	6	31.00	30.54	10	31.36	31.15
Nov. 1	32.18	31.55	7	30.85	30.49	11	31.34	31.20
2	31.60	30.88	8	30.87	30.45	12	31.70	31.20
3	31.31	30.81	9	30.67	30.49	13	31.82	31.70
4	31.31	30.95	10	30.72	30.38	17	31.70	31.12
5	30.98	30.48	11	31.26	30.38	18	31.40	31.12
6	30.60	30.35	12	31.20	30.25	19	31.54	31.20
7	30.62	30.39	13	31.17	30.27	20	31.44	31.07
8	30.51	29.92	14	31.14	30.76	23	31.40	31.12
9	30.18	29.69	15	31.42	30.88	24	31.70	31.40
10	30.35	30.08	16	31.59	31.37	25	31.70	31.39
11	30.33	29.98	17	31.60	31.42	26	31.53	31.36
12	30.50	29.78	18	31.50	31.32	27	31.49	31.10
13	30.22	29.63	19	31.37	31.05	28	31.13	30.90
14	30.48	30.20	20	31.65	31.07	29	31.24	30.87
15	30.21	29.50	21	31.65	31.10	Feb. 1	31.70	30.59
16	29.60	29.44	22	31.86	31.18	2	31.82	31.41
17	29.60	29.41	23	32.05	31.95	3	31.54	31.21
18	29.60	29.41	24	32.25	31.95	5	33.25	32.82
19	29.94	29.44	25	31.97	31.39	6	33.56	32.82
20	30.37	29.92	26	31.45	30.82	7	33.78	33.51
21	30.47	30.14	27	30.96	30.76	8	34.10	33.58
22	31.03	30.11	28	30.89	30.74	9	34.07	33.88
23	31.34	30.87	29	31.20	30.79	10	34.24	33.97
24	31.39	31.14	30	31.15	30.90	11	34.31	34.17
25	31.22	30.82	31	31.15	30.90	12	.....	34.16
26	30.92	30.73	1944			14	35.33	34.92
27	30.81	30.58	Jan. 1	31.30	30.95	15	35.68	34.88
28	31.10	30.75	2	31.28	30.95	16	35.75	35.34
29	31.05	30.80	3	31.10	30.43	17	35.49	34.88

TABLE 17—*Continued*

Bal-Gf 79. Bethlehem Steel Co.'s well, Open Hearth 1—*Continued*

Date	Depth to water Low	Depth to water High	Date	Depth to water Low	Depth to water High	Date	Depth to water Low	Depth to water High
1944			1944			1944		
Feb. 18	35.14	34.75	Apr. 6	35.18	34.93	May 15	38.95	38.34
19	35.52	35.15	7	35.06	34.66	16	38.42	38.07
20	35.40	34.79	8	35.15	34.81	17	38.22	37.88
21	34.86	34.69	9	35.20	34.77	18	38.01	37.58
22	34.88	34.18	10	34.83	34.40	19	37.95	37.44
23	.....	34.12	11	34.89	34.38	20	37.55	37.02
27	34.27	34.10	12	34.45	33.92	21	39.48	37.03
28	34.28	34.08	13	35.02	34.41	22	37.11	36.86
29	34.28	33.98	14	34.95	34.51	27	37.12	36.87
Mar. 6	35.03	34.82	15	34.76	34.34	28	37.12	36.75
7	34.85	34.60	16	34.78	34.54	29	35.30	37.03
11	36.47	36.19	17	35.20	34.78	June 3	37.21	36.88
12	36.26	35.64	18	.....	35.08	4	37.30	36.83
13	35.84	35.56	22	35.87	35.68	5	36.92	36.38
14	36.05	34.79	23	35.78	35.44	6	36.82	36.40
15	35.83	35.20	24	35.66	35.22	7	37.60	36.63
16	35.26	34.80	25	35.78	35.34	8	38.07	37.58
17	34.99	34.59	26	35.78	35.44	9	38.10	37.70
18	35.20	34.93	27	35.96	35.27	10	37.97	37.62
19	35.37	34.92	28	35.88	33.67	11	38.12	37.83
20	34.97	34.48	29	35.85	35.46	12	37.97	37.52
21	35.07	34.66	30	35.46	35.29	13	38.22	37.52
22	35.20	34.92	May 1	35.68	35.19	14	38.48	38.18
23	35.00	34.41	2	36.53	35.68	15	38.70	38.40
24	34.81	34.43	3	36.80	36.53	17	39.27	38.58
25	34.95	34.70	4	37.55	36.80	18	39.28	38.95
27	34.64	34.31	5	38.19	37.52	19	39.05	38.60
28	34.97	34.62	6	38.15	37.70	20	38.79	38.47
29	34.97	34.52	7	39.00	37.96	24	39.31	38.93
30	34.72	34.34	8	39.75	38.95	25	39.67	39.28
31	34.79	34.56	9	39.74	39.35	26	39.56	39.07
Apr. 1	34.79	34.51	10	39.57	39.28	27	39.66	39.25
2	34.80	34.51	11	39.66	39.39	28	39.70	39.38
3	34.91	34.65	12	39.67	39.35	29	39.86	39.51
4	34.78	34.16	13	39.58	39.12	30	40.29	39.55
5	35.00	34.26	14	39.16	38.86	July 1	40.29	39.99

TABLE 17—*Continued*

Bal-Gf 79. Bethlehem Steel Co.'s well, Open Hearth 1—*Continued*

Date	Depth to water Low	High	Date	Depth to water Low	High	Date	Depth to water Low	High
1944			1944			1944		
July 2	40.25	39.75	Aug. 10	36.84	36.15	Sept. 17	35.78	35.43
3	39.83	39.51	11	37.53	36.75	18	35.66	35.40
4	39.81	39.43	12	37.86	37.29	19	35.40	35.05
5	39.83	39.39	13	38.12	37.67	20	35.28	34.92
7	40.73	40.47	14	38.40	37.86	21	35.05	34.72
8	40.86	40.50	15	38.52	38.15	22	35.31	34.71
9	40.75	39.92	16	38.56	38.30	23	35.59	35.23
10	39.95	38.91	17	38.31	37.56	24	35.51	34.91
11	39.20	38.77	18	37.64	37.37	25	34.99	34.58
12	39.43	38.94	19	37.76	37.47	26	34.92	34.51
13	39.83	39.42	20	36.62	37.13	27	34.76	34.36
14	39.79	38.84	21	37.17	36.73	28	34.56	33.91
15	38.87	38.11	22	37.23	36.60	29	34.08	33.80
16	38.21	37.24	23	38.10	37.19	30	34.11	33.67
17	37.35	36.92	24	38.21	37.52	Oct. 1	33.75	32.90
18	37.30	36.81	25	38.19	37.71	2	33.02	32.73
19	36.93	36.29	26	37.79	37.34	3	33.09	32.76
20	36.34	35.97	27	37.53	36.94	4	32.91	32.50
21	36.20	35.85	28	37.12	36.53	5	32.74	32.50
22	36.14	35.66	29	35.73	36.20	6	32.62	32.42
23	35.70	35.14	30	35.75	36.40	7	32.79	32.48
24	35.19	34.74	31	35.71	36.30	8	33.38	32.70
25	35.73	35.06	Sept. 1	36.70	36.37	9	33.37	33.14
26	36.03	35.71	2	36.66	36.46	10	33.60	33.03
27	35.98	35.63	3	36.76	36.54	11	33.76	33.39
28	36.02	35.70	4	36.78	36.37	12	33.80	33.45
29	35.99	35.57	5	36.47	36.30	13	33.79	33.26
30	36.07	35.72	6	36.52	36.27	14	33.30	32.84
31	36.29	35.75	7	36.54	36.16	15	33.97	33.10
Aug. 1	36.46	36.08	8	36.52	36.24	16	34.00	33.34
2	36.39	35.62	9	36.41	36.10	17	33.66	33.36
3	36.54	35.64	10	36.33	35.87	18	33.55	33.10
4	36.69	36.28	11	35.91	35.40	19	33.14	32.83
5	36.49	36.17	12	35.60	35.10	20	33.11	32.30
6	36.56	36.11	13	35.22	34.84	21	32.63	31.98
7	36.35	36.08	14	35.51	34.77	22	32.88	32.50
8	36.45	36.06	15	35.52	35.04	23	32.58	32.21
9	36.33	35.91	16	35.74	35.21	24	32.51	32.06

TABLE 17 – *Continued*

Bal-Gf 79. Bethlehem Steel Co.'s well, Open Hearth 1 – *Continued*

Date	Depth to water Low	Depth to water High	Date	Depth to water Low	Depth to water High	Date	Depth to water Low	Depth to water High
1944			1944			1945		
Oct. 25	32.53	32.21	Dec. 1	31.30	30.76	Jan. 6	30.44	30.18
26	32.56	32.03	2	31.47	31.26	7	30.34	29.75
27	33.20	32.27	4	31.47	31.06	8	30.64	30.04
28	33.39	33.07	5	31.06	30.56	9	30.68	30.43
29	33.33	33.05	6	30.56	30.25	10	30.78	30.68
30	33.41	32.96	7	30.36	30.15	11	30.72	30.46
31	33.57	33.32	8	30.25	29.68	12	30.69	29.94
Nov. 1	34.23	33.57	9	30.60	29.86	13	30.44	29.98
2	35.00	34.22	10	30.61	30.51	14	30.44	30.12
3	34.67	33.89	11	30.61	29.80	15	30.16	29.74
4	33.89	33.18	12	29.99	29.42	16	30.13	29.68
5	33.26	32.98	13	.....	29.99	17	30.57	29.99
6	33.06	32.80	14	31.08	30.96	18	30.72	30.47
7	33.04	32.83	15	31.11	30.76	19	30.64	30.29
8	32.96	32.70	16	30.80	30.58	20	30.46	30.18
9	32.92	32.62	17	30.87	30.48	21	30.46	30.05
10	32.63	32.20	18	30.58	30.39	22	30.19	29.64
11	33.00	32.53	19	31.05	30.33	23	30.10	29.76
12	33.10	32.72	20	31.04	30.38	24	30.57	29.96
13	33.44	32.79	21	30.70	30.14	25	31.30	30.57
14	33.42	32.97	22	31.30	30.70	26	31.13	31.00
15	32.97	32.29	23	31.02	30.48	27	31.41	31.08
16	32.60	32.29	24	30.58	30.26	28	31.34	31.00
17	32.73	32.46	25	30.43	29.85	29	31.01	30.88
18	32.50	31.90	26	30.64	29.90	30	31.11	30.88
19	32.02	31.54	27	30.72	30.08	31	31.67	30.88
20	31.53	31.11	28	30.62	30.08	Feb. 1	32.05	31.63
21	31.94	31.21	29	30.98	30.62	2	32.17	32.03
22	31.93	31.43	30	30.77	30.45	3	32.19	32.10
23	31.48	30.98	31	30.50	29.73	4	32.12	31.10
24	31.02	30.77	1945			5	31.36	30.86
25	31.35	31.03	Jan. 1	29.79	29.20	6	31.35	31.02
26	31.29	30.90	2	30.63	29.54	7	31.08	30.86
27	30.96	30.28	3	30.80	30.60	8	30.87	30.47
28	30.77	30.34	4	30.66	30.37	9	30.54	30.35
30	30.87	30.62	5	30.57	30.36	10	30.46	30.18

TABLE 17—*Continued*

Bal-Gf 79. Bethlehem Steel Co.'s well, Open Hearth 1—*Continued*

Date		Depth to water		Date		Depth to water		Date		Depth to water	
		Low	High			Low	High			Low	High
1945				1945				1945			
Feb.	11	30.54	30.31	Mar.	19	30.40	29.97	May	8	32.29	31.62
	12	30.54	30.34		20	30.27	29.92		9	32.02	31.80
	13	30.50	30.21		21	30.25	29.77		10	32.03	31.17
	14	30.49	30.20		22	30.22	29.83		11	31.84	31.44
	15	30.40	29.96		23	30.39	29.98		12	31.84	31.15
	16	30.40	29.94		24	30.20	29.90		13	31.15	30.83
	17	30.63	30.31		25	30.30	30.01		14	31.12	30.84
	18	30.60	30.32		26	30.18	29.88		15	30.91	30.53
	19	30.93	30.54		27	30.11	29.81		16	30.81	30.64
	20	30.94	30.53		28	30.45	30.08		17	30.86	30.58
	21	30.74	30.44		29	30.63	30.40		18	30.62	30.36
	22	30.55	30.06		30	30.95	30.58		19	31.50	30.62
	23	30.56	30.10		31	30.94	30.57		20	31.50	30.69
	24	30.89	30.51	Apr.	1	30.98	30.72		21	30.74	30.11
	25	31.02	30.83		2	30.86	30.29		22	30.37	30.08
	26	30.94	30.45		3	30.87	30.46		25	30.97	30.66
	27	30.86	30.22		4	30.92	30.42		26	31.20	30.70
	28	30.91	30.61		5	30.92	30.14		27	30.93	30.52
Mar.	1	30.87	30.58		6	31.61	30.92		28	30.91	30.50
	2	30.87	30.43		7	31.61	31.40		29	31.41	30.49
	3	30.47	30.20		8	31.63	31.20		30	31.52	31.41
	4	30.61	30.43		9	31.27	31.03	June	1	32.86	32.66
	5	30.58	30.21		10	31.25	31.03		2	32.75	32.13
	6	30.41	29.88		11	31.19	30.87		3	32.39	31.88
	7	30.58	29.98		12	31.06	30.75		4	32.27	31.92
	8	30.77	30.53		13	31.04	30.80		5	32.49	32.03
	9	30.76	30.40		14	30.98	30.65		6	32.51	32.09
	10	30.73	30.38		15	31.12	30.85		7	33.00	32.10
	11	30.86	30.66		16	31.04	30.55		12	33.87	33.24
	12	30.83	30.12		17	31.26	30.94		13	34.22	33.69
	13	30.60	30.34		18	32.00	31.23		14	34.33	33.99
	14	30.66	30.33		20	31.50	31.06		15	34.36	34.02
	15	30.72	30.27	May	4	32.39	31.89		16	34.27	33.94
	16	30.37	30.08		5	33.10	32.34		17	34.25	33.85
	17	30.48	30.18		6	33.26	33.02		18	34.06	33.70
	18	30.58	30.26		7	33.22	32.29		19	33.93	33.68

TABLE 17—*Continued*

Bal-Gf 79. Bethlehem Steel Co.'s well, Open Hearth 1—*Continued*

Date	Depth to water		Date	Depth to water		Date	Depth to water	
	Low	High		Low	High		Low	High
1945			1945			1945		
June 22	35.58	35.10	Aug. 10	33.22	32.95	Sept. 15	31.38	30.85
23	35.67	35.30	11	33.16	32.91	16	31.62	31.32
24	35.49	34.60	12	33.08	32.80	17	31.57	30.95
25	34.80	33.23	13	32,84	32,65	18	30.95	30.23
26	33.23	32.22	14	32.78	32.55	19	31.42	30.56
27	32.70	31.83	15	32.56	32.34	20	31.46	31.22
28	31.83	31.26	16	32.54	32.30	21	31.86	31.35
29	31.54	31.33	17	32.30	31.97	22	32.11	31.86
July 13	33.71	33.52	18	32.14	31.92	23	31.96	31.48
14	33.72	33.24	19	32.14	31.96	24	31.51	31.45
15	33.24	32.77	20	32.11	31.80	26	31.51	31.45
16	33.47	32.88	21	32.47	31.81	27	31.78	31.48
17	33.40	33.12	22	33.00	32.36	28	31.62	31.37
18	33.30	32.97	23	33.26	32.86	29	31.50	31.22
19	33.29	33.10	24	33.37	32.56	30	31.50	31.45
20	33.36	33.05	25	32.78	31 96	Oct. 1	31.49	30.55
21	33.46	33.18	26	32.04	31.88	2	30.62	30.26
22	33.46	33.08	27	32.00	31.86	5	31.11	30.95
23	33.13	32.84	28	31.86	31.55	6	31.14	30.76
24	33.04	32.78	29	31.87	31.50	7	30.88	30.74
25	32.90	32.61	30	31.98	31.67	8	30.89	30.51
26	32.64	32.56	31	31.96	31.78	9	31.32	30.57
27	33.04	32.79	Sept. 1	32.11	31.58	10	31.46	31.24
28	33.19	32.85	2	32.31	31.99	11	31.45	30.89
29	32.98	32.81	3	32.33	32.06	12	30.89	30.42
30	33.28	33.00	4	32.07	31.62	13	31.00	30.40
31	33.27	33.15	5	31.70	31.44	14	30.89	30.39
Aug. 1	33.30	33.04	6	31.57	31.29	15	30.55	30.29
2	33.32	33.17	7	31.43	31.11	16	30.51	30.17
3	33.18	32.92	8	31.14	30.92	17	30.47	30.25
4	33.55	33.00	9	30.97	30.84	18	30.46	30.15
5	33.55	33.12	10	30.92	30.78	19	30.42	30.17
6	33.31	32.69	11	30.81	30.59	20	30.43	30.10
7	33.10	32.78	12	31.36	30.73	26	30.68	30.17
8	33.30	33.00	13	31.30	31.18	27	31.21	30.63
9	33.37	33.02	14	31.21	30.86	28	31.26	31.01

TABLE 17 – *Continued*

Bal-Gf 79. Bethlehem Steel Co.'s well, Open Hearth 1 – *Continued*

Date	Depth to water Low	High	Date	Depth to water Low	High	Date	Depth to water Low	High
1945			1945			1945		
Oct. 29	31.25	31.13	Nov. 17	30.13	29.97	Dec. 9	29.49	29.27
30	31.20	30.90	18	30.10	29.95	10	29.80	29.18
31	31.01	30.74	19	30.08	29.36	11	30.24	29.79
Nov. 1	31.04	30.83	20	30.08	29.40	12	30.40	30.10
2	31.04	30.40	21	30.17	29.69	13	30.40	30.10
3	30.63	30.40	22	29.69	29.48	14	30.10	29.80
4	30.92	30.63	23	29.95	29.47	17	30.16	30.08
5	30.87	30.40	24	29.96	29.81	18	30.22	30.16
6	30.47	30.38	25	29.96	29.75	19	30.26	29.93
7	30.40	30.17	26	29.96	29.90	20	30.08	29.84
8	30.18	29.96	27	29.94	29.57	21	30.23	29.81
9	30.12	29.91	28	29.67	29.17	22	30.20	29.89
10	30.37	29.96	29	30.53	29.66	23	30.49	30.02
11	30.30	29.81	30	30.80	30.52	24	30.30	29.96
12	29.87	29.70	Dec. 1	30.83	30.46	25	29.96	29.16
13	29.71	29.50	2	30.48	29.50	28	29.99	29.77
14	30.01	29.49	3	29.50	29.29	29	29.78	29.44
15	30.72	30.01	7	29.57	29.35	30	29.49	28.62
16	30.70	30.06	8	29.68	29.35	31	29.04	28.60

Bal-Gf 89. Bethlehem Steel Co.'s well, Blast Furnace 1, Sparrows Point. Unused drilled industrial well, diameter 8 to 4½ inches, depth 286 feet. Measuring point, edge of baffle bell, 2.70 feet above land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1941		1943		1944	
Apr. 26	[b]126	Aug. 25	54.24	Jan. 8	53.47
1943		Sept. 1	54.19	Feb. 5	56.58
May 20	[b]73.65	7	54.13	Mar. 11	60.18
July 26	51.90	Oct. 7	54.15	1945	
Aug. 5	54.30	Nov. 3	54.10	June 16	[b]63
11	54.34	Dec. 9	53.52	Nov. 5	49.20
18	54.63				

[b]*Water level reported.*

TABLE 17—*Continued*

Bal-Gf 93. Bethlehem Steel Co.'s well, Blast Furnace 4, Sparrows Point. Used drilled industrial well, diameter 10 to 4½ inches, depth 513 feet. Measuring point, top of iron plate at pump base, 4.65 feet above land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1939		1943		1943	
November	[b]136	July 26	100.83	Sept. 7	98.70
1940		Aug. 5	101.60	Oct. 7	106.92
November	[b]158	11	107.36	Nov. 3	97.72
1941		13	93.75	1944	
Apr. 26	[b]137	23	95.40	Feb. 5	107.92
Sept. 27	[b]140	Sept 1	95.28	Mar. 25	[b]103

[b]*Water level reported.*

Bal-Gf 100. Bethlehem Steel Co.'s well, Blast Furnace 8, Sparrows Point. Unused drilled industrial well, diameter 12 to 4½ inches, depth 284 feet. Measuring point, edge of baffle bell, 3.20 feet above land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1940		1943		1943	
January	[b]121	May 20	80.42	Nov. 3	48.21
1941		July 26	101.57	Dec. 9	54.73
Apr. 26	[b]116	Aug. 5	63.94	1944	
Sept. 27	[b]142	11	60.52	Jan. 8	55.97
1942		18	59.06	Feb. 5	56.90
May	[b]137	25	56.39	1945	
November	[b]129	Sept. 1	55.85	Nov. 5	54.25
1943		7	57.85		
January	[b]105	Oct. 7	61.08		

[b]*Water level reported.*

TABLE 17 – *Continued*

Bal-Gf 105. Bethlehem Steel Co.'s well, Spray Pond 1, Sparrows Point. Used drilled industrial well, diameter 16 to 4½ inches, depth 538 feet. Measuring point, top of air line, 3.00 feet above land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1932		1941		1943	
--------	[b]50	Sept. 27	[b]109	Sept. 7	[a]156
1939		1942		Oct. 7	[a]163
October	[b]135	November	[b]97	Nov. 3	[a]147
December	[b]132	1943		1945	
1940		January	[b]85	June 16	[b]63
October	[b]117	April	[b]87		
1941		May 20	[b]81		
Apr. 26	[b]105	Aug. 5	[a]155		

[a]*Well pumping at time of measurement.*
[b]*Water level reported.*

Bal-Gf 107. Bethlehem Steel Co.'s well, Benzol Boiler 1, Sparrows Point. Used drilled industrial well, diameter 10 to 4 inches, depth 271 feet. Measuring point, edge of baffle bell, 7.90 feet above land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1930		1943		1944	
--------	[b]89	January	[b]102	Apr. 21	62.50
1940		May 27	[b]79.5	May 9	63.69
January	[b]114	July 26	113.67	June 13	61.43
1941		Aug. 11	61.78	July 13	68.82
Apr. 27	[b]116	25	57.39	1945	
Sept. 30	[b]142	Dec. 9	56.12	June 4	[b]55
1942		1944		Oct. 16	55.32
June	[b]128	Feb. 5	57.83		
November	[b]129	Mar. 11	65.48		

[b]*Water level reported.*

TABLE 17 – *Continued*

Bal-Gf 108. Bethlehem Steel Co.'s well, Benzol Boiler 2, Sparrows Point. Used drilled industrial well, diameter 10 to 4 inches, depth 271 feet. Measuring point, edge of baffle bell, 7.10 feet above land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1930		1942		1943	
--------	[b]90	June	[b]108	Aug. 11	62.76
1940		November	[b]129	25	58.37
January	[b]112	1943		Dec. 9	57.11
1941		January	[b]104	1945	
Apr. 27	[b]117	May 27	[b]80.5	June 4	[b]56
Sept. 30	[b]141	July 26	115.07	Oct. 16	56.32

[b]*Water level reported.*

Bal-Gf 129. Bethlehem Steel Co.'s well, Coke Oven 21, Sparrows Point. Unused drilled industrial well, diameter 12 to 4½ inches, depth 279 feet. Measuring point, top of discharge pipe, 1.00 foot below land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1940		1943		1943	
October	[b]86	July 26	124.30	Sept. 1	62.52
1942		Aug. 5	71.35	7	55.31
November	[b]145	11	66.51	Oct. 7	69.60
1943		18	67.46	1945	
Apr. 27	[b]88.05	25	62.37	May 31	[b]60
				Oct. 22	61.86

[b]*Water level reported.*

TABLE 17 – *Continued*

Bal-Gf 130. Bethlehem Steel Co.'s well, Coke Oven 22, Sparrows Point. Unused drilled industrial well, diameter 12 to 4½ inches, depth 309 feet. Measuring point, top of 6-inch flange, 2.00 feet below land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1917		1943		1944	
--------	[b]60	Aug. 5	71.34	Jan. 8	58.66
1942		Sept. 7	52.90	Feb. 5	60.58
November	[b]135	Oct. 7	66.49	1945	
1943		Nov. 4	44.57	May 31	[b]60.5
Apr. 27	[b]103.4	Dec. 9	58.47	Oct. 22	67.94

[b]*Water level reported.*

Bal-Gf 131. Bethlehem Steel Co.'s well, Coke Oven 23, Sparrows Point. Unused drilled industrial well, diameter 8 to 6 inches, depth 274 feet. Measuring point, edge of tee in 4-inch discharge pipe, 1.50 feet above land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1943		1943		1944	
Aug. 5	73.56	Nov. 4	44.16	Feb. 7	68.11
Sept. 7	52.32	Dec. 9	61.39	1945	
Oct. 7	68.50	1944		May 31	[b]58.3
		Jan. 8	62.32	Oct. 22	61.57

[b]*Water level reported.*

TABLE 17– *Continued*

Bal-Gf 136. Bethlehem Steel Co.'s well, Coke Oven 28, Sparrows Point. Unused drilled industrial well, diameter 12 to 4½ inches, depth 494 feet. Measuring point, edge of baffle bell, at land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1926		1943		1944	
July	87.09	Sept. 1	83.32	Mar. 4	84.62
1941		7	84.17	Apr. 21	83.63
September	[b]135	Oct. 7	92.46	May 9	87.20
1943		Nov. 4	85.68	June 13	79.37
Aug. 5	87.87	Dec. 9	100.55	July 13	79.43
11	93.13	1944		1945	
18	88.56	Jan. 8	99.59	Oct. 22	74.73
25	83.43	Feb. 5	96.53		

[b]*Water level reported.*

Bal-Gf 138. Bethlehem Steel Co.'s well, Coke Oven 30, Sparrows Point. Used drilled industrial well, diameter 16 to 6 inches, depth 295 feet. Measuring point, top of air line, 2.70 feet above land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1936		1943		1944	
--------	[b]85	May 27	[b]82	Jan. 8	57
1940		Aug. 5	63	Feb. 5	57
October	[b]146	Sept. 7	50	1945	
1941		Oct. 7	59	May 31	[b]51
September	[b]137	Nov. 4	42	Oct. 22	56.39
1942		Dec. 9	52		
November	[b]127				

[b]*Water level reported.*

TABLE 17—*Continued*

Bal-Gf 139. Bethlehem Steel Co.'s well, Coke Oven 31, Sparrows Point. Used drilled industrial well, diameter 16 to 7 inches, depth 615 feet. Measuring point, top of air line, 3.00 feet above land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1939		1943		1944	
--------	[b]112	Sept. 7	76	Apr. 16	[b]76.5
December	[b]130	Oct. 7	84	21	76
1940		Nov. 4	80	May 9	[a]125
November	[b]129	Dec. 9	[a]168	June 13	72
1942		1944		July 13	73
November	[b]112	Jan. 8	[a]166	1945	
1943		Feb. 5	[a]164	May 31	[b]75
May 27	[b]85	Mar. 11	81	Oct. 22	71

[a]*Well pumping at time of measurement.*
[b]*Water level reported.*

Bal-Gf 140. Bethlehem Steel Co.'s well, Coke Oven 32, Sparrows Point. Used drilled industrial well, diameter 14 to 7 inches, depth 302 feet. Measuring point, top of air line, 2.00 feet above land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1940		1943		1944	
--------	[b]120	May 27	[b]85	Jan. 8	66
October	[b]150	Aug. 5	73	Feb. 5	67
1941		Sept. 7	54	1945	
September	[b]142	Oct. 7	71	May 31	[b]63
1942		Nov. 4	47	Oct. 22	62.23
November	[b]128	Dec. 9	64		

[b]*Water level reported.*

TABLE 17—*Continued*

Bal-Gf 166. Bethlehem Steel Co.'s well, Town Water 1, Sparrows Point. Used drilled industrial well, diameter 10 to 4½ inches, depth 222 feet. Measuring point, edge of baffle bell, 6.60 feet above land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1940		1943		1943	
January	[b]74	Aug. 11	34.60	Dec. 2	32.71
1941		18	33.08	1944	
Apr. 26	[b]75	25	32.22	Jan. 8	29.14
Sept.27	[b]77	Sept. 1	31.19	Feb. 5	32.40
1943		8	31.33	Mar. 11	35.90
July 26	39.25	Oct. 7	31.68	1945	
Aug. 4	38.93	Nov. 3	29.80	May 18	[b]28.2
				Oct. 16	27.06

[b]*Water level reported.*

Bal-Gf 167. Bethlehem Steel Co.'s well, Town Water 2, Sparrows Point. Used drilled industrial well, diameter 10 to 4½ inches, depth 301 feet. Measuring point, edge of baffle bell, 6.40 feet above land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1940		1943		1944	
January	[b]110	January	[b]97	Jan. 8	55.45
1941		April	[b]57	Feb. 5	58.75
Apr. 26	[b]122	Sept. 8	54.38	1945	
Sept. 27	[b]127	Oct. 7	56.25	May 18	[b]58.3
1942		Nov. 3	53.43	Oct. 16	56.01
November	[b]122	Dec. 2	63.05		

[b]*Water level reported.*

TABLE 17--*Continued*

Bal-Gf 168. Bethlehem Steel Co.'s well, Town Water 3, Sparrows Point. Used drilled industrial well, diameter 10 to 4½ inches, depth 308 feet. Measuring point, edge of baffle bell, 6.40 feet above land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1940		1943		1944	
January	[b]104	April	[b]94	Mar. 11	64.78
1941		Sept. 8	54.49	Apr. 15	55.13
Apr. 26	[b]77	Oct. 7	56.40	May 9	67.85
Sept. 27	[b]127	Nov. 3	53.59	June 13	78.90
1942		Dec. 2	60.62	July 13	71.62
May	[b]119	1944		1945	
November	[b]124	Jan. 8	55.77	May 18	[b]58.1
		Feb. 5	59.04	Oct. 16	56.20

[b]*Water level reported.*

Bal-Gf 169. Bethlehem Steel Co.'s well, Town Water 4, Sparrows Point. Used drilled industrial well, diameter 10 to 4½ inches, depth 224 feet. Measuring point, edge of baffle bell, 4.80 feet above land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1940		1943		1944	
January	[b]70	April	[b]40	Mar. 11	37.25
1941		Aug. 4	41.43	Apr. 15	34.57
Apr. 26	[b]77	Sept. 8	32.76	May 9	42.02
Sept. 27	[b]79	Oct. 7	33.20	June 13	40.00
1942		Nov. 3	31.33	July 13	42.87
May	[b]72	Dec. 2	34.11	1945	
November	[b]75	1944		May 18	[b]29.6
December	[b]57	Jan. 8	30.44	Oct. 16	28.83
		Feb. 5	33.64		

[b]*Water level reported.*

TABLE 17 — *Continued*

Bal-Gf 170. Bethlehem Steel Co.'s well, Town Water 5, Sparrows Point. Used drilled industrial well, diameter 10 to 4½ inches, depth 223 feet. Measuring point, edge of baffle bell, 5.40 feet above land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1940		1943		1944	
January	[b]77	January	[b]55	Jan. 8	29.90
1941		April	[b]38	Feb. 5	33.02
Apr. 26	[b]78	Sept. 8	32.11	Mar. 11	36.68
Sept. 27	[b]79	Oct. 7	32.50	1945	
1942		Nov. 3	30.65	May 18	[b]28.9
May	[b]117	Dec. 2	33.31	Oct. 16	28.01
November	[b]75				

[b]*Water level reported.*

Bal-Gf 171. Bethlehem Steel Co.'s well, Town Water 6, Sparrows Point. Used drilled industrial well, diameter 10 to 6 inches, depth 290 feet. Measuring point, edge of baffle bell, 5.50 feet above land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1940		1943		1943	
January	[b]80	April	[b]55	Nov. 3	58.29
1941		July 26	73.80	Dec. 2	61.66
Apr. 26	[b]101	Aug. 11	65.30	1944	
Sept. 27	[b]124	18	59.35	Jan. 8	57.82
1942		25	61.65	Feb. 5	61.44
May	[b]74	Sept. 1	58.73	1945	
November	[b]131	8	58.84	May 18	[b]60.2
1943		Oct. 7	60.66	Oct. 16	56.73
January	[b]76				

[b]*Water level reported.*

TABLE 17—*Continued*

Bal-Gf 172. Bethlehem Steel Co.'s well, Town Water 7, Sparrows Point. Used drilled industrial well, diameter 10 to 4½ inches, depth 317 feet. Measuring point, edge of baffle bell, 5.50 feet above land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1926		1942		1943	
July	69.38	December	[b]57	Oct. 7	56.65
1939		1943		Nov. 3	54.20
December	[b]100	April	[b]54	Dec. 2	56.79
1941		Aug. 4	70.38	1944	
May	[b]130	11	60.99	Jan. 8	52.58
Sept. 27	[b]125	18	57.37	Feb. 5	55.78
1942		25	57.60	1945	
March	[b]74	Sept. 1	54.88	May 18	[b]54.0
November	[b]122	8	54.96	Oct. 16	52.53

[b]*Water level reported.*

Bal-Gf 173. Bethlehem Steel Co.'s well, Town Water 8, Sparrows Point. Used drilled industrial well, diameter 10 to 4½ inches, depth 226 feet. Measuring point, edge of baffle bell, 5.00 feet above land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1940		1943		1944	
January	[b]73	Sept. 8	33.28	Jan. 8	31.01
1941		Oct. 7	34.04	Feb. 5	34.21
Apr. 26	[b]80	Nov. 3	31.81	Mar. 11	37.69
Sept. 27	[b]78	Dec. 2	34.39	1945	
				May 18	[b]30.6
				Oct. 16	29.68

[b]*Water level reported.*

TABLE 17 — *Continued*

Bal-Gf 174. Bethlehem Steel Co.'s well, Town Water 9, Sparrows Point. Used drilled industrial well, diameter 10 to 4½ inches, depth 318 feet. Measuring point, edge of baffle bell, 5.90 feet above land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1939		1942		1943	
October	[b]104	November	[b]76	Dec. 2	58.37
1940		1943		1944	
January	[b]108	January	[b]104	Jan. 8	54.03
1941		April	[b]54	Feb. 5	57.72
Apr. 26	[b]139	Aug. 4	89.51	1945	
Sept. 27	[b]144	Sept. 8	74.26	May 18	[b]45.4
1942		Oct. 7	76.84	Oct. 16	54.93
May	[b]119	Nov. 3	73.42		

[b]*Water level reported.*

Bal-Gf 175. Bethlehem Steel Co.'s well, Town Water 10, Sparrows Point. Used drilled industrial well, depth 300 feet. Measuring point, top of air line, 2.00 feet above land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1936		1941		1943	
--------	[b]74	Apr. 26	[b]119	Sept. 1	54
1937		Sept. 27	[b]98	8	55
Jan. 8	[b]70	1942		Oct. 7	58
1938		April	[b]113	Nov. 3	55
May 31	[b]86	November	[b]114	Dec. 2	[a]77
1939		1943		1944	
October	[b]97	January	[b]98	Jan. 8	[a]93
December	[b]96	April	[b]50	Feb. 5	[a]97
1940		Aug. 4	76	1945	
January	[b]116	11	63	May 18	[b]58
Feb. 25	[b]121	18	59	Oct. 16	[a]103
November	[b]116	25	57		

[a]*Well pumping at time of measurement.*
[b]*Water level reported*

TABLE 17—*Continued*

Bal-Gf 176. Bethlehem Steel Co.'s well, Town Water 11, Sparrows Point. Used drilled industrial well, diameter 14 to 7 inches, depth 322 feet. Measuring point, top of air line, 2.00 feet above land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1940		1942		1943	
--------	[b]108	November	[b]113	Nov. 3	[a]102
Feb. 25	[b]121	1943		Dec. 2	56
1941		January	[b]93	1944	
February	[b]117	April	[b]58	Jan. 8	53
Sept. 27	[b]98	Aug. 4	[a]117	Feb. 5	57.5
1942		Sept. 8	[a]103	1945	
May	[b]118	Oct. 7	[a]102	May 18	[b]83
				Oct. 16	56.07

[a]*Well pumping at time of measurement.*
[b]*Water level reported.*

Bal-Gf 177. Bay Shore Park. Longitude 76°25'30", latitude 39°12'30". Used, drilled well, diameter 6 inches, depth 743 feet. Measuring point, lock flange on well platform, 1.20 feet above land surface. Automatic water-stage recorder installed July 24, 1943 to July 21, 1944. Water level reported 15 feet above land surface in 1907. Water levels, in feet below land-surface datum, Feb. 14, 1941, 35.9 (reported); Oct. 21, 1945, 30.25.

Daily highest and lowest water levels, in feet below land-surface datum
(From recorder charts)

Date	Depth to water		Date	Depth to water		Date	Depth to water	
	Low	High		Low	High		Low	High
1943			1943			1943		
July 24	45.27	45.02	July 28	45.00	44.82	Aug. 1	45.15	45.04
25	45.00	44.70	29	44.97	44.81	2	45.10	45.05
26	45.08	44.70	30	45.16	44.80	3	45.10	44.90
27	45.10	45.00	31	45.15	45.06	4	45.06	44.95

TABLE 17—*Continued*

Bal-Gf 177. Bay Shore Park—*Continued*

Date	Depth to water		Date	Depth to water		Date	Depth to water	
	Low	High		Low	High		Low	High
1943			1943			1943		
Aug. 5	45.50	45.08	Sept. 29	44.92	44.63	Nov. 8	44.06	43.34
6	45.47	44.95	Oct. 1	45.93	44.92	9	44.01	43.14
7	44.93	44.70	2	45.18	44.92	10	44.27	43.96
8	44.93	44.67	3	45.68	45.18	11	44.28	43.97
9	44.67	44.50	7	46.32	46.07	12	44.56	43.70
10	44.77	44.30	8	46.44	46.13	13	44.54	43.70
11	44.77	44.35	9	46.44	45.75	14	45.16	44.54
12	44.40	44.18	10	46.38	45.65	15	44.90	44.22
13	44.60	44.10	11	46.38	45.47	16	44.99	44.22
14	45.10	44.60	12	45.60	45.23	17	45.32	44.75
Sept. 3	43.46	43.18	13	45.53	45.19	18	44.75	44.55
4	43.17	42.95	14	45.37	44.96	19	44.70	44.51
5	42.99	42.89	15	45.15	44.64	20	44.89	44.68
6	42.99	42.75	16	44.74	44.00	21	44.92	44.72
7	43.02	42.65	17	45.02	44.00	22	45.65	44.68
8	43.32	42.92	18	45.00	44.55	23	45.78	45.60
9	43.28	42.90	19	45.30	44.56	24	45.78	45.30
10	43.43	42.90	20	45.22	44.90	25	45.30	44.98
11	43.43	43.03	21	44.92	44.48	26	45.25	44.81
12	43.43	43.08	22	44.71	44.25	27	45.10	44.81
13	43.40	42.86	23	44.81	44.66	28	45.65	44.99
14	43.05	42.80	24	44.81	44.63	29	45.62	45.23
15	43.01	42.72	25	44.66	44.18	30	45.65	45.30
16	43.05	42.72	26	44.57	44.22	Dec. 1	45.58	45.30
17	43.97	43.02	27	44.57	43.76	2	45.75	45.19
18	44.46	43.95	28	43.91	43.70	3	46.08	45.56
19	44.04	43.78	29	44.50	43.72	4	46.16	45.80
20	43.90	43.67	30	44.67	44.30	5	46.21	45.62
21	44.12	43.68	31	44.89	44.52	6	46.21	45.88
22	44.26	44.04	Nov. 1	45.66	44.27	7	46.34	45.80
23	44.26	43.85	2	44.27	43.74	8	46.34	45.80
24	44.34	43.86	3	44.48	43.74	9	46.23	45.85
25	44.34	44.05	4	44.36	44.36	10	46.38	45.94
26	44.30	44.21	5	44.30	43.86	11	47.18	46.04
27	44.33	44.18	6	44.12	43.73	12	47.11	45.85
28	44.63	44.24	7	44.13	43.99	13	47.07	45.98

TABLE 17—*Continued*

Bal-Gf 177. Bay Shore Park—*Continued*

Date	Depth to water Low	High	Date	Depth to water Low	High	Date	Depth to water Low	High
1943			1944			1944		
Dec. 14	46.73	46.43	Jan. 26	47.05	46.77	Mar 4	46.39	46.00
15	47.27	46.43	27	47.02	46.72	5	46.47	46.23
16	47.33	46.90	28	46.81	46.48	6	46.61	46.28
17	47.32	47.00	29	46.81	46.58	7	46.35	45.72
18	47.08	46.90	30	46.85	46.57	8	46.48	46.08
19	47.24	46.94	31	46.77	46.25	9	47.30	46.48
20	47.58	46.83	Feb. 1	47.20	46.11	10	47.29	46.90
21	47.58	46.78	2	47.23	46.58	11	47.02	46.37
22	47.68	46.85	3	46.58	46.17	12	46.46	45.95
23	47.96	47.58	4	46.57	46.17	13	46.34	45.95
24	48.20	47.78	5	46.76	45.94	14	46.47	45.95
25	47.75	47.22	6	46.80	45.94	15	45.95	45.61
26	47.60	46.92	7	46.78	46.04	16	45.81	45.48
27	47.41	46.92	8	46.70	46.30	17	45.89	45.46
28	47.21	46.85	9	46.39	46.14	18	46.30	45.89
29	47.54	46.94	10	46.70	46.39	19	46.83	46.16
30	47.44	46.96	11	46.41	46.18	20	46.16	45.62
31	47.42	46.96	12	47.00	46.26	21	46.35	46.02
1944			14	46.59	46.16	22	46.63	46.25
Jan. 8	47.49	47.11	15	46.94	46.16	23	46.42	45.74
9	47.50	47.02	16	47.20	46.94	24	46.30	45.80
10	47.22	46.90	17	47.27	46.55	25	46.30	45.95
11	47.17	46.91	18	46.84	46.39	26	46.46	45.98
12	47.46	46.89	19	47.30	46.86	27	46.50	46.01
13	47.70	47.29	20	47.08	46.58	28	46.68	46.12
14	47.54	47.20	21	46.84	46.58	29	46.60	45.73
15	47.39	47.13	22	46.80	45.86	30	45.92	45.64
16	47.40	47.20	23	46.57	45.86	31	45.95	45.79
17	47.25	46.80	24	46.67	46.28	Apr. 1	45.94	45.55
18	47.12	46.88	25	46.67	46.28	2	46.21	45.67
19	47.07	46.70	26	46.42	46.06	3	46.24	45.76
20	46.70	46.26	27	45.40	46.06	4	45.76	45.13
21	46.84	46.28	28	46.27	46.12	5	46.10	45.21
22	47.12	46.48	29	46.39	45.95	6	46.13	46.57
23	46.99	46.82	Mar. 1	47.09	46.39	7	45.57	45.13
24	47.30	46.80	2	47.09	46.66	8	45.64	45.33
25	47.22	46.90	3	46.66	45.92	9	45.75	45.21

TABLE 17—*Continued*

Bal-Gf 177. Bay Shore Park—*Continued*

Date	Depth to water Low	Depth to water High	Date	Depth to water Low	Depth to water High	Date	Depth to water Low	Depth to water High
1944			1944			1944		
Apr. 10	45.21	44.76	May 14	42.27	41.89	June 17	40.44	40.00
11	45.41	44.64	15	42.26	41.86	18	40.46	40.16
12	44.74	44.15	16	41.98	41.72	19	40.34	39.80
13	45.18	44.49	17	41.84	41.64	20	40.11	39.41
14	44.97	44.40	18	41.83	41.51	21	40.29	40.07
15	44.61	43.99	19	41.98	41.64	22	40.17	39.69
16	44.17	43.75	20	41.88	41.27	23	39.87	39.54
17	43.96	43.75	21	41.98	41.60	24	39.66	39.28
18	43.98	43.67	22	41.65	41.30	25	40.00	39.64
19	43.68	43.29	23	41.74	41.42	26	39.80	39.30
20	43.50	43.08	24	41.76	41.33	27	39.93	39.54
21	43.11	42.77	25	41.67	41.35	28	39.98	39.76
22	43.10	42.68	26	41.80	41.56	29	39.95	39.72
23	42.77	42.45	27	41.86	41.64	30	40.31	39.61
24	42.78	42.28	28	42.10	41.67	July 1	40.31	40.08
25	42.66	42.16	29	42.29	42.08	2	40.19	39.68
26	42.68	42.30	30	42.27	41.77	3	40.02	39.64
27	42.75	42.22	31	41.90	41.68	4	40.02	39.55
28	42.98	42.69	June 1	41.90	41.54	5	40.14	39.60
29	42.83	42.65	2	41.90	41.60	6	40.26	39.83
30	42.63	42.23	3	41.78	41.24	7	40.23	39.73
May 1	42.42	42.09	4	41.84	41.35	8	40.05	39.62
2	42.50	42.25	5	41.35	40.90	9	40.02	39.61
3	42.50	43.31	6	41.36	40.95	10	39.94	39.73
4	42.67	42.32	7	41.70	40.86	11	40.05	40.83
5	42.73	42.52	8	41.91	41.36	12	40.02	39.79
6	42.60	41.99	9	41.40	40.96	13	40.56	39.85
7	42.00	41.52	10	41.02	40.61	14	40.76	40.62
8	42.27	42.00	11	41.22	40.77	15	40.76	40.46
9	42.03	41.61	12	41.17	40.54	16	40.77	40.33
10	42.00	41.70	13	40.76	40.44	17	41.07	40.53
11	42.16	41.90	14	40.76	40.42	18	41.07	40.77
12	42.17	41.87	15	40.53	40.10	19	40.97	40.65
13	42.08	41.80	16	40.53	40.10	20	40.86	40.50
						21	41.04	40.86

TABLE 17 – *Continued*

Bal-Gf 183. Chesapeake Terrace School, Lodge Forest. In pump house. Unused drilled public well, diameter 8 inches, depth 307 feet. Measuring point, top of cement well curb which is 4.00 feet below land surface.

Water level, in feet below land-surface datum

Date	Depth to water	Date	Depth to water	Date	Depth to water
1944		1944			
June 12	36.11	June 26	36.22		

Daily highest and lowest water levels, in feet below land-surface datum (From recorder charts)

Date	Depth to water		Date	Depth to water		Date	Depth to water	
	Low	High		Low	High		Low	High
1944			1944			1944		
Sept. 3	33.92	33.75	Sept. 25	32.73	32.42	Oct. 17	31.52	31.52
4	34.00	33.80	26	32.45	32.33	18	31.52	31.52
5	34.11	33.94	27	32.36	32.25	19	31.52	31.51
6	34.11	33.97	28	32.27	32.02	20	31.51	31.45
7	34.15	33.98	29	32.04	31.94	21	31.45	31.16
8	34.12	33.71	30	32.09	31.93	22	31.16	31.15
9	33.72	33.60	Oct. 1	31.95	31.54	23	31.15	31.14
10	33.72	33.49	2	31.54	31.29	24	31.14	31.14
11	33.49	33.19	3	31.38	31.33	25	31.14	31.13
12	33.19	32.98	4	31.32	31.23	26	31.13	31.11
13	32.98	32.68	5	31.22	31.18	27	31.11	31.11
14	32.68	32.35	6	31.18	31.15	28	31.11	31.11
15	32.86	32.35	7	31.15	31.14	29	31.11	31.11
16	32.99	32.63	8	31.20	31.14	30	31.11	31.11
17	33.13	32.95	9	31.37	31.20	31	31.14	31.11
18	32.98	32.86	10	31.43	31.37	Nov. 1	31.25	31.14
19	32.88	32.78	11	31.47	31.43	2	31.98	31.25
20	32.82	32.71	12	31.57	31.47	3	32.09	31.98
21	32.71	32.51	13	31.58	31.53	4	32.09	32.09
22	32.68	32.40	14	31.53	31.37	5	32.09	32.09
23	32.94	32.68	15	31.37	31.34	6	32.09	32.09
24	32.93	32.73	16	31.52	31.34	7	32.09	32.09

TABLE 17—*Continued*

Bal-Gf 183. Chesapeake Terrace School—*Continued*

Date	Depth to water Low	Depth to water High	Date	Depth to water Low	Depth to water High	Date	Depth to water Low	Depth to water High
1944			1944			1945		
Nov. 8	32.09	32.03	Dec. 24	29.17	29.17	Mar. 29	28.80	28.65
9	32.09	31.13	25	29.17	29.17	30	29.08	28.80
10	31.13	30.85	26	29.17	29.17	31	29.20	28.88
16	30.80	30.61	27	29.17	29.17	Apr. 1	29.20	28.88
17	30.92	30.61	28	29.17	29.17	2	29.20	28.77
18	30.87	30.51	29	29.16	29.16	3	28.89	28.77
19	30.51	30.27	30	29.16	29.16	4	29.13	28.89
20	30.30	30.21	31	29.16	29.16	5	28.95	28.65
21	30.21	30.18	1945			6	29.42	28.65
22	30.25	30.18	Jan. 1	29.16	29.16	13	29.37	29.21
23	30.24	29.54	2	29.16	29.16	14	29.27	29.09
24	29.78	29.42	3	29.16	29.16	15	29.40	29.22
25	29.91	29.78	4	29.17	29.03	16	29.39	29.01
30	29.40	29.18	5	29.05	29.00	17	29.25	29.07
Dec. 1	29.66	29.19	6	29.05	28.95	18	29.65	29.17
2	30.08	29.66	7	28.95	28.91	19	30.15	29.65
3	30.17	30.08	8	28.91	28.89	20	30.18	29.41
4	30.15	29.94	9	28.89	28.89	21	29.59	29.25
5	29.94	29.70	10	28.93	28.89	22	29.58	29.27
6	29.70	29.40	11	29.08	28.93	23	29.55	29.44
7	29.54	29.51	12	29.18	28.68	24	29.44	29.05
8	29.51	29.16	13	28.90	28.68	25	29.05	29.00
9	29.16	29.16	14	28.92	28.90	26	29.00	28.98
10	29.16	29.16	15	28.92	28.88	27	29.40	28.95
11	29.16	29.16	16	28.88	28.80	28	30.10	29.40
12	29.16	29.15	17	28.80	28.79	29	30.37	30.10
13	29.15	29.15	18	28.81	28.79	30	30.21	29.82
14	29.15	29.15	Mar. 15	29.55	28.75	May 1	30.06	29.82
15	29.15	29.15	16	28.88	28.67	2	30.38	29.96
16	29.15	29.15	17	28.99	28.80	3	30.32	29.95
17	29.15	29.15	22	28.75	28.48	4	30.89	29.90
18	29.15	29.15	23	28.80	28.32	5	31.41	30.89
19	29.15	29.15	24	28.53	28.32	6	31.83	31.41
20	29.15	29.15	25	28.75	28.47	7	31.90	31.27
21	29.15	29.15	26	28.75	28.52	8	31.27	30.40
22	29.17	29.15	27	28.52	28.45	9	30.40	30.22
23	29.17	29.17	28	28.65	28.45	10	30.34	30.27

TABLE 17—*Continued*

Bal-Gf 183. Chesapeake Terrace School—*Continued*

Date	Depth to water Low	High	Date	Depth to water Low	High	Date	Depth to water Low	High
1945			1945			1945		
May 11	30.27	30.08	June 17	31.03	30.99	July 26	30.80	30.78
12	30.22	29.76	18	30.99	30.86	27	30.88	30.82
13	29.76	29.50	19	30.86	30.84	28	31.01	30.88
14	29.73	29.48	20	31.07	30.84	29	30.96	30.87
15	29.51	29.25	21	31.43	31.07	30	31.02	30.87
16	29.28	29.24	22	31.78	31.43	31	31.12	31.02
18	29.24	28.99	23	32.19	31.78	Aug. 1	31.14	31.09
19	29.58	29.07	24	32.28	32.19	2	31.16	31.10
20	29.64	29.28	25	32.25	31.26	3	31.15	31.08
21	29.28	28.75	26	31.66	31.12	4	31.30	31.11
22	28.81	28.75	27	31.17	30.64	5	31.40	31.30
23	29.05	28.81	28	30.64	30.33	6	31.37	31.00
24	29.13	29.05	29	30.33	30.32	7	31.05	30.94
25	29.15	29.09	July 3	30.62	30.33	8	31.12	31.05
26	29.13	28.78	4	30.73	30.62	9	31.26	31.11
27	28.78	28.68	5	30.73	30.44	10	31.23	31.20
28	28.81	28.71	6	30.52	30.39	11	31.21	31.11
29	28.90	28.72	7	30.79	30.52	17	30.55	30.33
30	29.15	28.90	8	31.08	30.79	18	30.33	30.19
31	29.44	29.15	9	31.13	30.97	19	30.25	30.21
June 1	29.62	29.44	10	31.02	30.97	20	30.28	30.15
2	29.62	29.47	11	31.41	30.98	21	30.18	30.12
3	29.47	29.27	12	31.59	31.41	22	30.17	30.12
4	29.37	29.30	13	31.51	31.37	23	30.32	30.14
5	29.50	29.37	14	31.45	31.35	24	30.40	30.07
6	29.51	29.45	15	31.35	30.85	25	30.10	29.93
7	29.63	29.45	16	31.04	30.85	26	30.03	29.88
8	30.07	29.63	17	31.14	31.04	27	30.09	30.03
9	30.44	30.07	18	31.08	31.04	28	30.09	29.89
10	30.48	30.25	19	31.11	31.04	29	29.89	29.82
11	30.27	29.99	20	31.24	31.11	30	29.97	29.83
12	30.39	30.12	21	31.27	31.24	31	30.13	29.97
13	30.65	30.39	22	31.35	31.27	Sept. 1	30.13	29.91
14	30.90	30.65	23	31.27	31.02	2	30.30	29.93
15	31.04	30.90	24	31.08	30.97	3	30.40	30.30
16	31.08	31.02	25	30.98	30.80	4	30.34	30.00

TABLE 17—*Continued*

Bal-Gf 183. Chesapeake Terrace School—*Continued*

Date	Depth to water		Date	Depth to water		Date	Depth to water	
	Low	High		Low	High		Low	High
1945			1945			1945		
Sept. 5	30.00	29.85	Oct. 12	29.43	29.01	Nov. 18	28.65	28.65
6	29.89	29.83	13	29.11	28.97	19	28.65	28.45
7	29.83	29.57	14	29.14	29.11	20	28.45	28.15
8	29.57	29.40	15	29.14	29.10	21	28.57	28.45
9	29.40	29.32	16	29.10	29.09	22	28.61	28.20
10	29.32	29.27	17	29.09	29.06	23	28.64	28.17
11	29.27	29.11	18	29.06	28.98	24	28.50	28.29
12	29.32	29.10	19	28.98	28.76	25	28.47	28.41
13	29.42	29.32	20	28.83	28.76	26	28.50	28.47
14	29.42	29.27	21	28.89	28.76	27	28.50	28.40
15	29.33	29.19	22	28.76	28.66	28	28.40	28.19
16	29.67	29.33	23	28.66	28.44	29	28.84	28.19
17	29.67	29.44	24	28.52	28.43	30	29.24	28.84
18	29.44	28.61	25	28.65	28.52	Dec. 1	29.24	29.10
19	29.05	28.61	26	28.75	28.68	2	29.10	28.82
20	29.38	29.05	27	29.17	28.75	3	28.82	28.32
21	29.51	29.38	28	29.28	29.17	4	28.32	28.20
22	29.84	29.51	29	29.37	29.28	7	28.17	27.96
23	29.86	29.73	30	29.38	29.31	8	28.06	27.91
24	29.73	29.59	31	29.31	29.23	10	28.12	28.00
25	29.59	29.45	Nov. 1	29.23	29.04	11	28.40	28.12
26	29.45	29.42	2	29.16	29.03	12	28.59	28.40
27	29.60	29.43	3	29.17	29.16	13	28.70	28.59
28	29.66	29.60	4	29.17	28.90	17	28.51	28.45
29	29.66	29.50	5	28.91	28.90	18	28.74	28.51
30	29.79	29.50	6	29.20	28.91	20	28.60	28.55
Oct. 1	29.80	29.27	7	29.20	29.18	21	28.59	28.49
2	29.27	28.87	8	29.25	29.18	22	28.63	28.59
3	29.21	28.87	9	28.63	28.63	23	28.84	28.59
4	29.63	29.21	10	28.68	28.60	24	28.84	28.72
5	29.68	29.33	11	28.77	28.68	25	28.72	28.17
6	29.33	29.13	12	28.77	28.58	26	28.17	27.98
7	29.13	29.12	13	28.58	28.38	27	27.99	27.98
8	29.12	29.05	14	28.38	28.25	28	28.25	27.99
9	29.10	28.85	15	28.55	28.25	29	28.32	28.25
10	29.38	29.10	16	28.79	28.55	30	28.26	27.75
11	29.43	29.38	17	28.68	28.65	31	27.75	27.72

A. Conglomerate of Pleistocene age, capping the hills on the southwest side of the Fairfield and Curtis Bay districts

B. Falls and rapids formed on the crystalline rocks in Gwynns Falls, 0.25 mile upstream from Baltimore Street

A. Openings along joint and foliation planes in crystalline rocks on west side of Gwynns Falls, 0.25 mile upstream from Baltimore Street

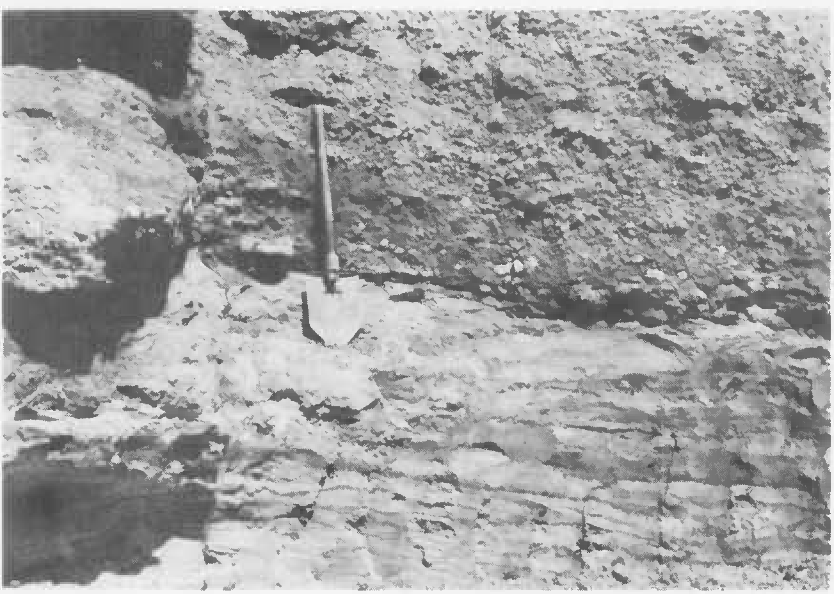
B. Lower part of Patuxent formation at Diamond Grit Company quarry, 0.3 mile east of Baltimore City limits, near U. S. Highway 40

Indurated rock layers in lower part of Patuxent formation; on south side of U. S. Highway 40, 0.3 mile east of Baltimore city limits

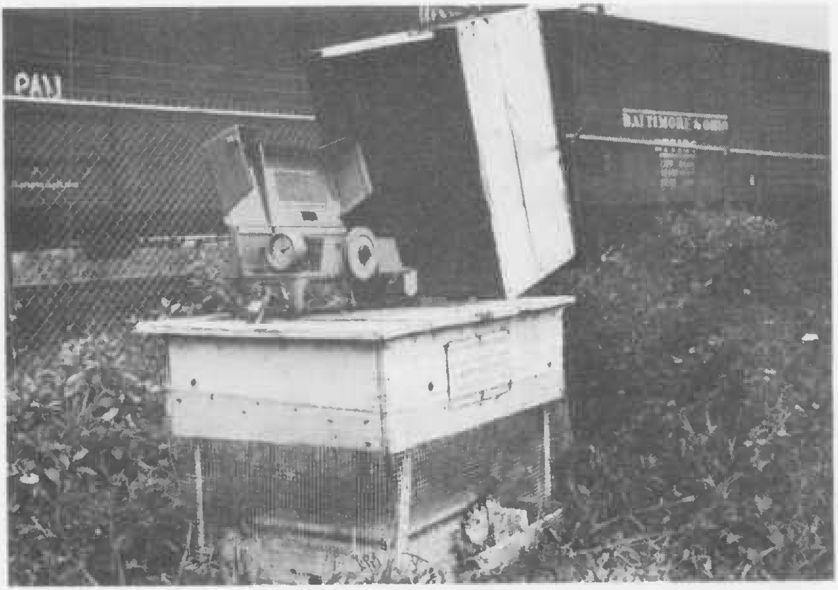
A. Thin seams of iron-oxide-cemented sand in lower part of Patuxent formation; on south side of U. S. Highway 40, 0.3 mile east of Baltimore city limits

B. Conglomerate in basal part of Patuxent formation; on south side of U. S. Highway 40, 0.3 mile east of Baltimore city limits

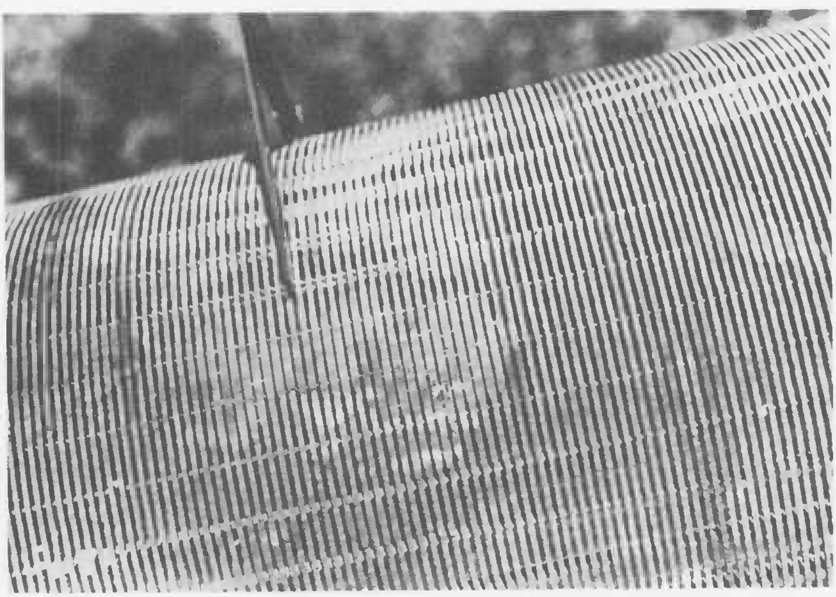
A. Sandy clay in the Patapsco formation overlain by darker-colored conglomerate, gravel, and clay of Pleistocene age; exposed in quarry in southwest part of Fairfield and Curtis Bay districts



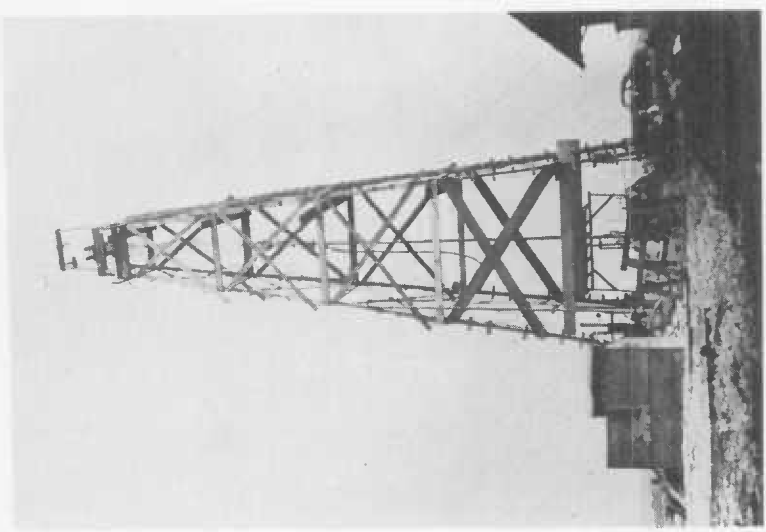
B. Gravel and clay of Pleistocene age (upland unit) overlying unconformably the lighter-colored sandy clay of the Patapsco formation; exposed in southwest part of Curtis Bay district



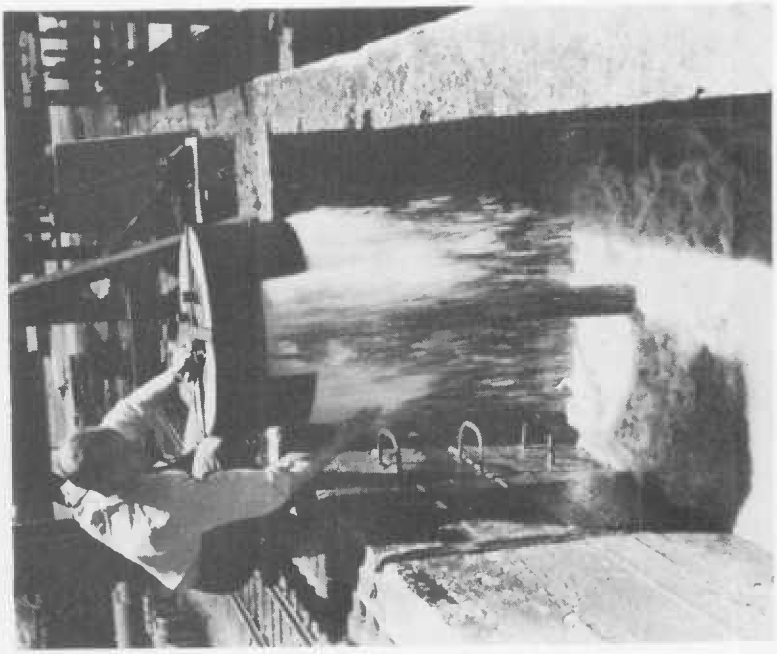
A. Automatic water-level recorder on well Bal-Fe 19 (Dundalk district)



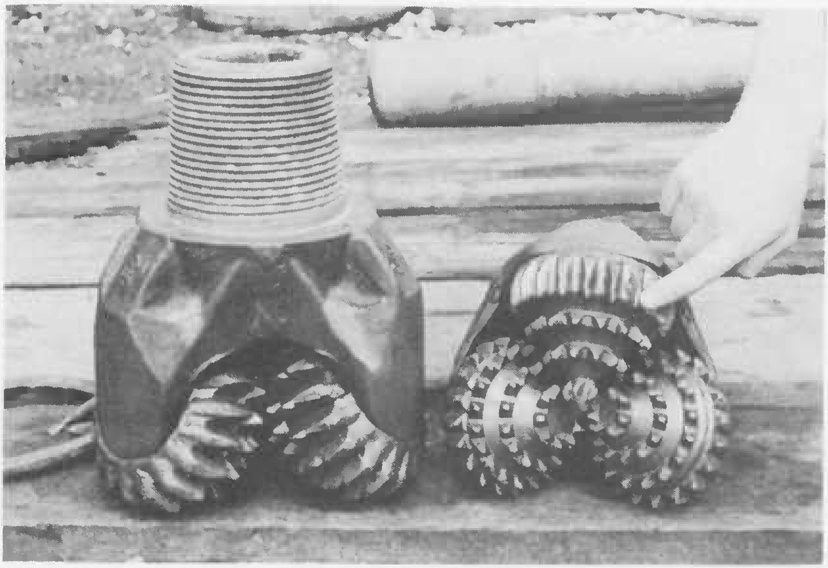
B. Corrosion in well screen from well 6S2E-1 in Curtis Bay district. Slot size of screen originally was 0.020 inch; feeler gauge inserted in slot is 0.045 inch. (Furnished by U. S. Industrial Chemical Co.)



A. Wood derrick used with rotary-drilling equipment in drilling large-diameter industrial wells in the Baltimore industrial area



B. Well Bal-Gf 47 (Sparrows Point district), equipped with air-lift pump



A. Rock bit commonly used in rotary drilling of large-diameter industrial wells in the Baltimore industrial area

B. Well Bal-Gf 9 (Sparrows Point district), equipped with deep-well turbine pump

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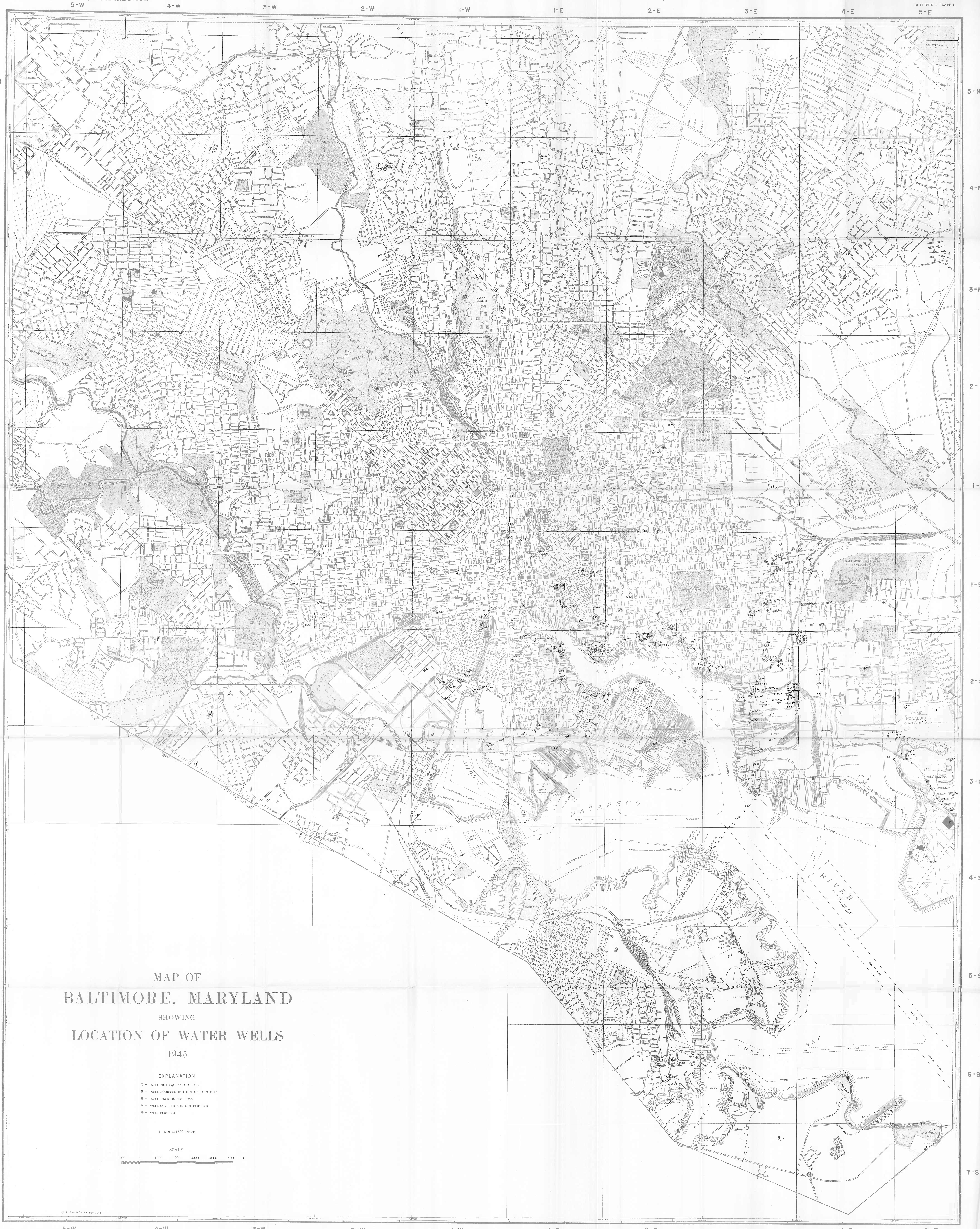
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2-S
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5-S
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7-S
DRUID HILL PARK
DRUID LAKE
PATTERSON PARK
NORTH WEST BRANCH
MIDDLE BRANCH
PATAPSCO
RIVER
CHERRY HILL
CURTIS BAY
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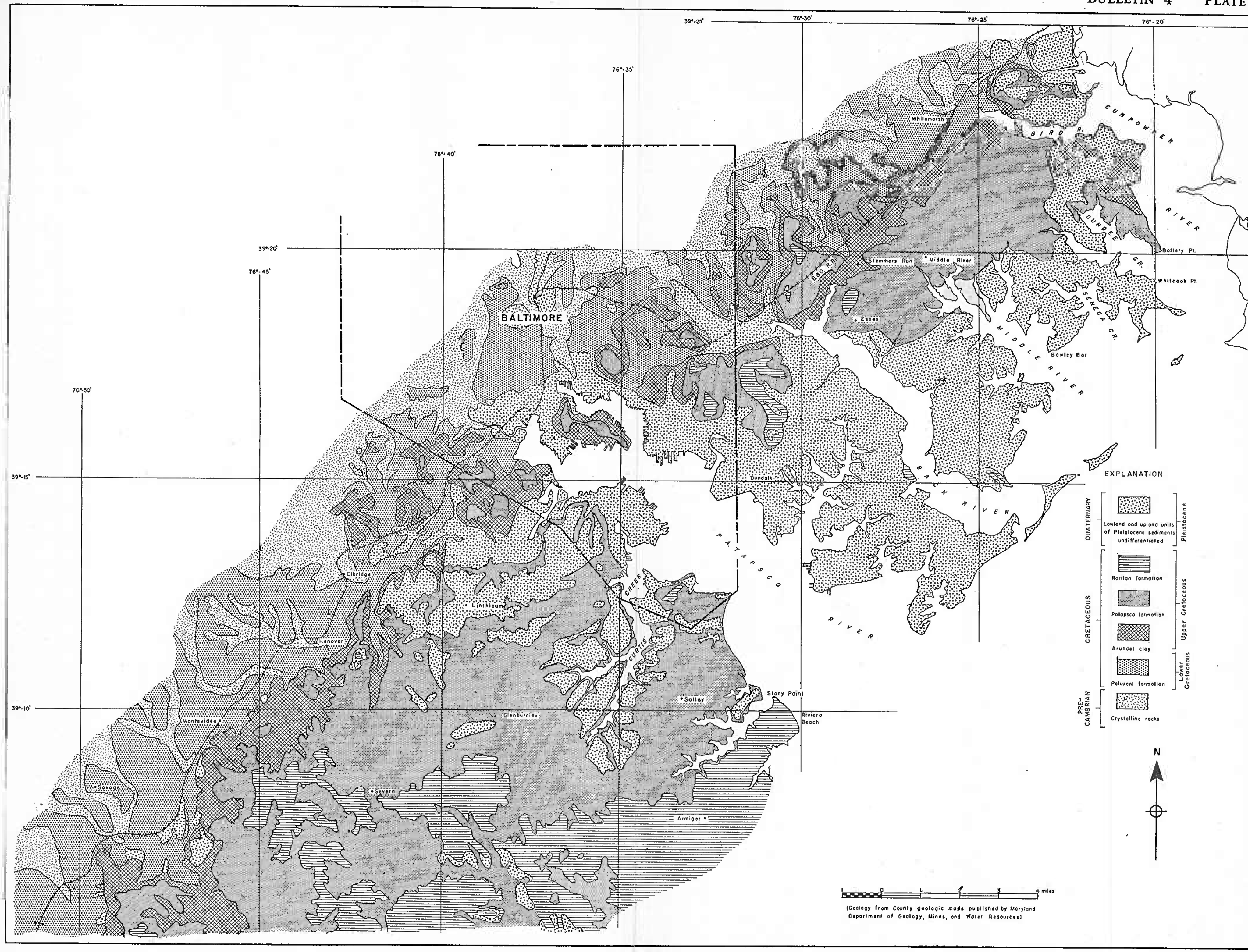
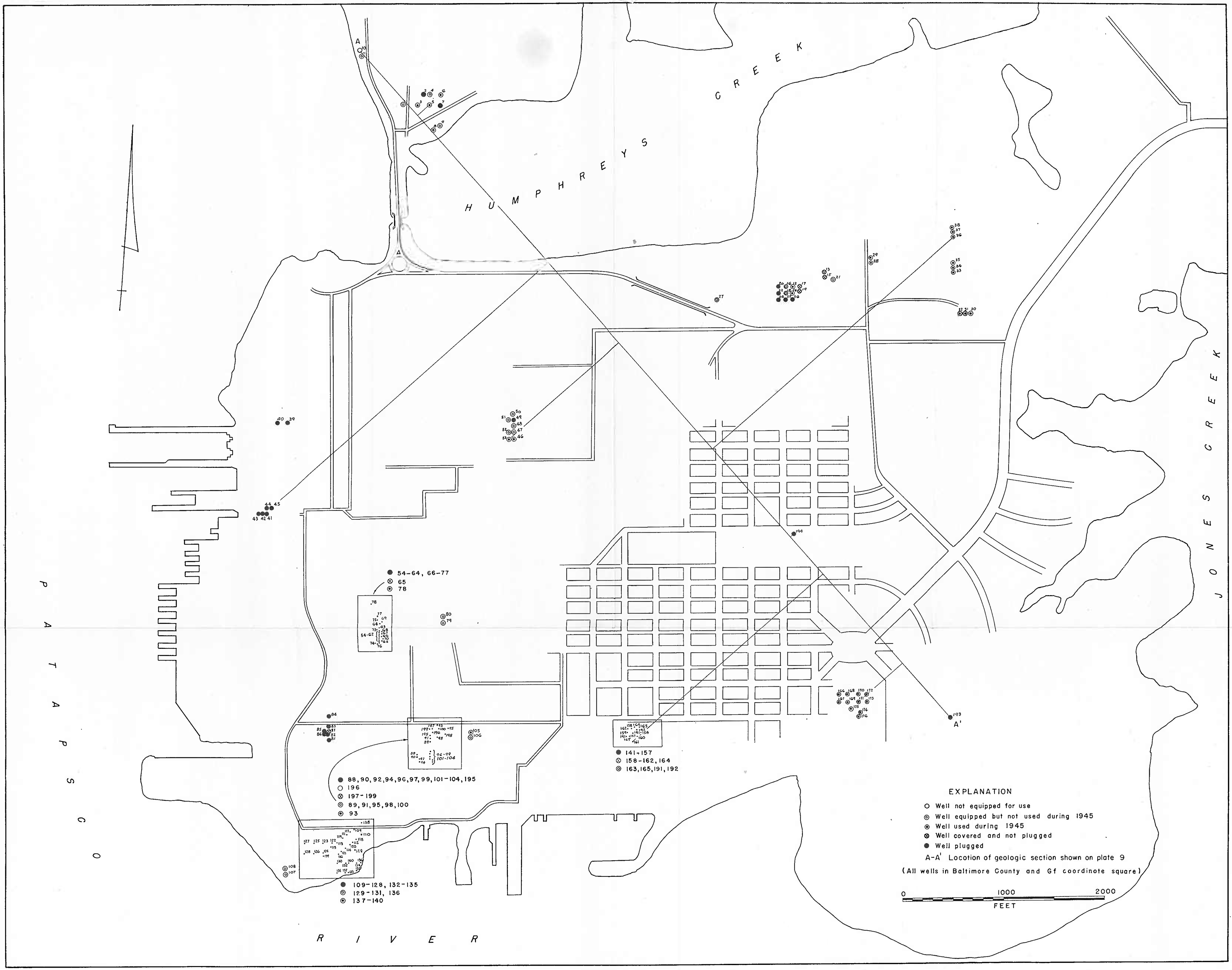
LOCATION OF WATER WELLS
1945
EXPLANATION
WELL NOT EQUIPPED FOR USE
WELL EQUIPPED BUT NOT USED IN 1945
WELL USED DURING 1945
WELL COVERED AND NOT PLUGGED
WELL PLUGGED
1 INCH = 1500 FEET
SCALE
1000 0 1000 2000 3000 4000 5000 FEET
© A. Hoen & Co., Inc.-Dec. 1946

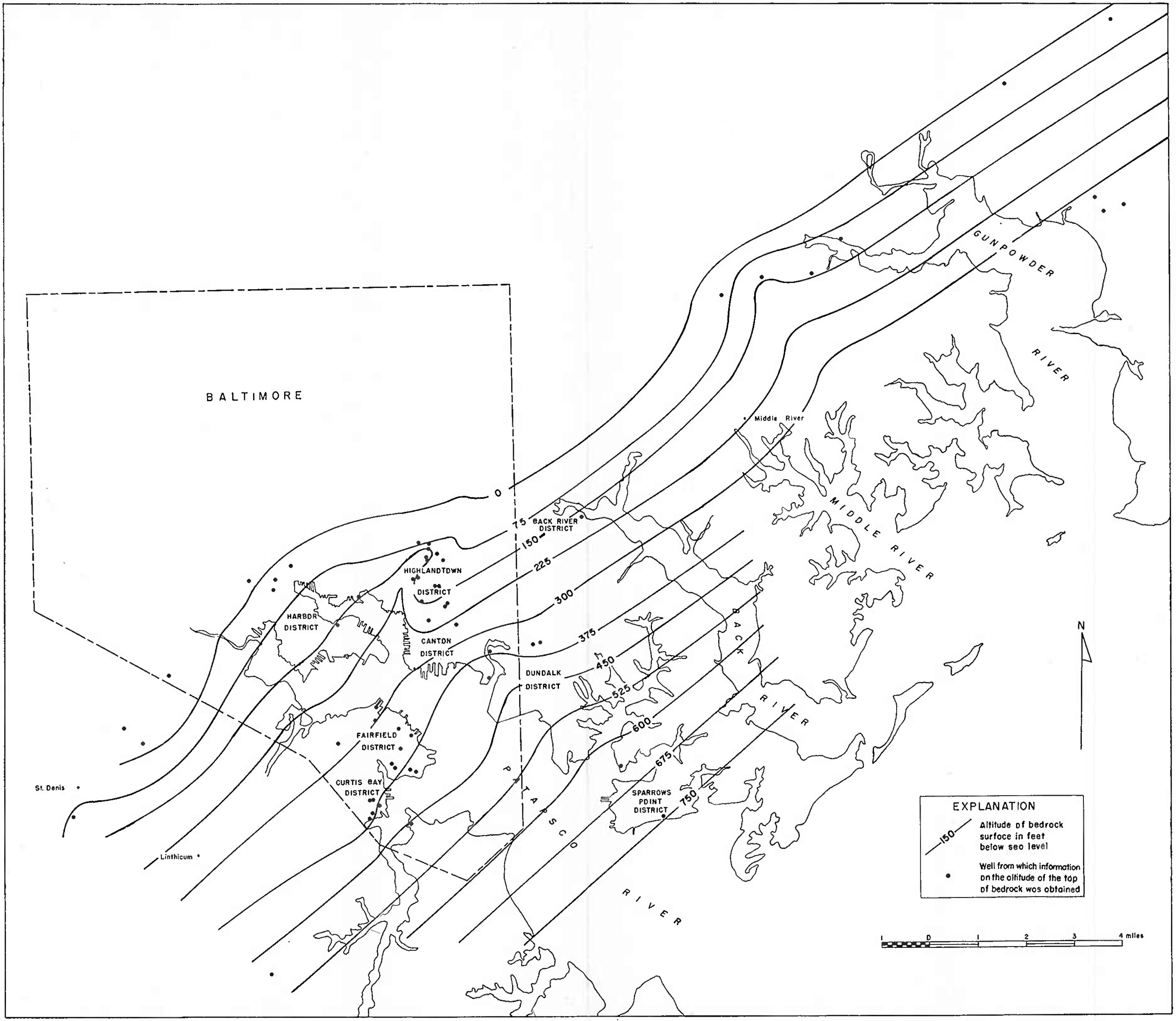


GEOLOGIC MAP OF BALTIMORE, MARYLAND, AND VICINITY

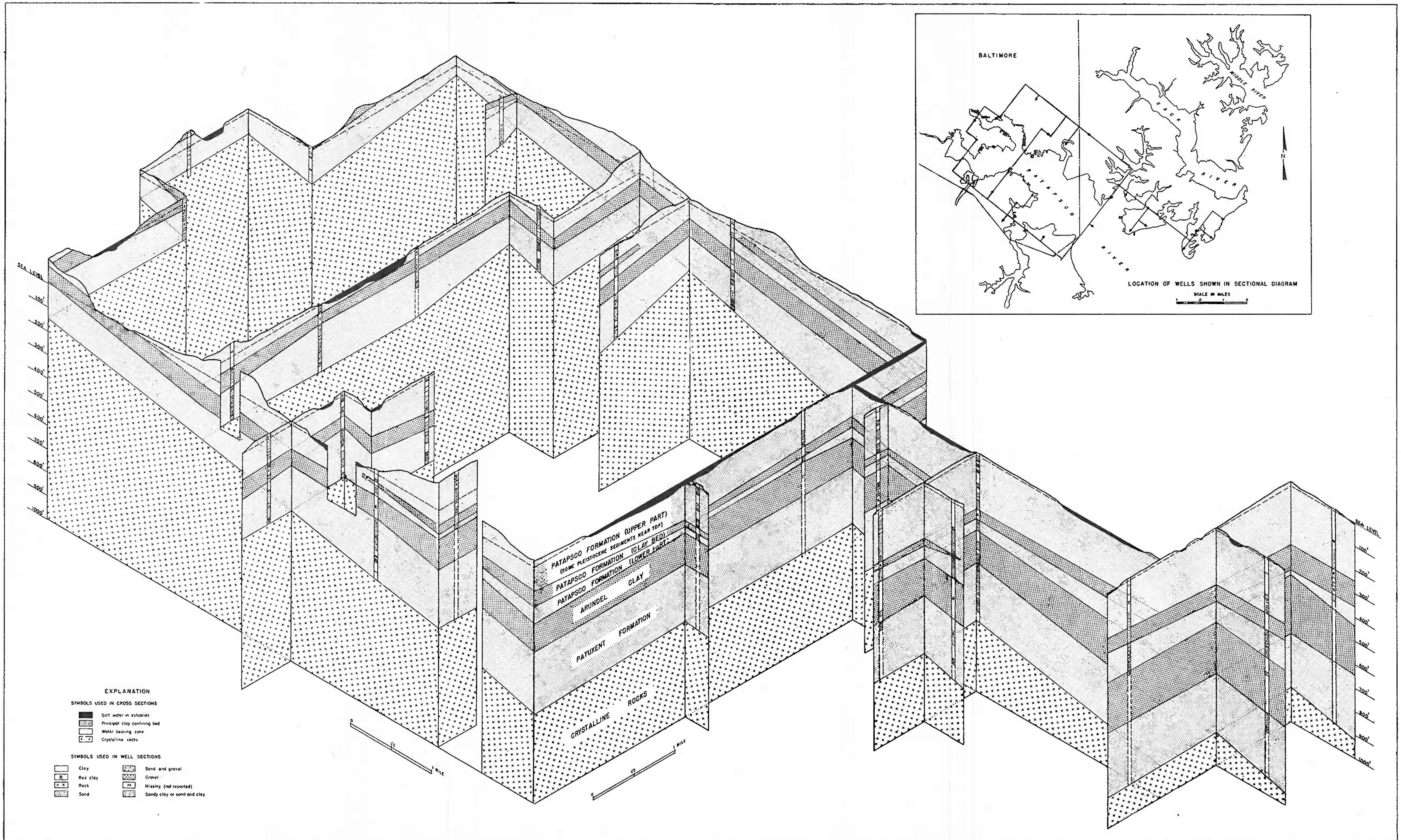
MAP SHOWING THE LOCATION OF WATER WELLS IN THE BALTIMORE AREA, MARYLAND



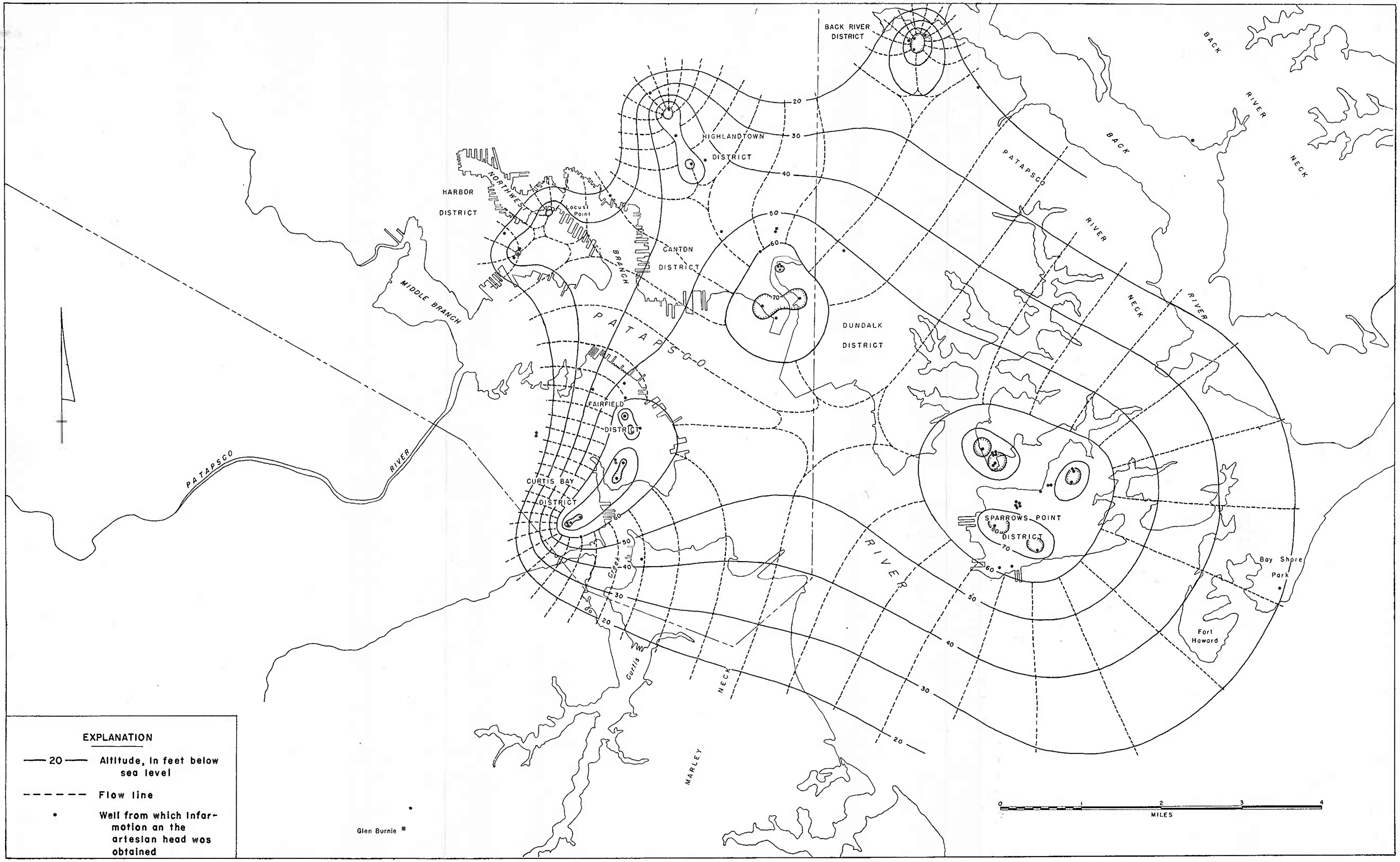
MAP OF THE SPARROWS POINT DISTRICT, MARYLAND, SHOWING THE LOCATION OF WATER WELLS



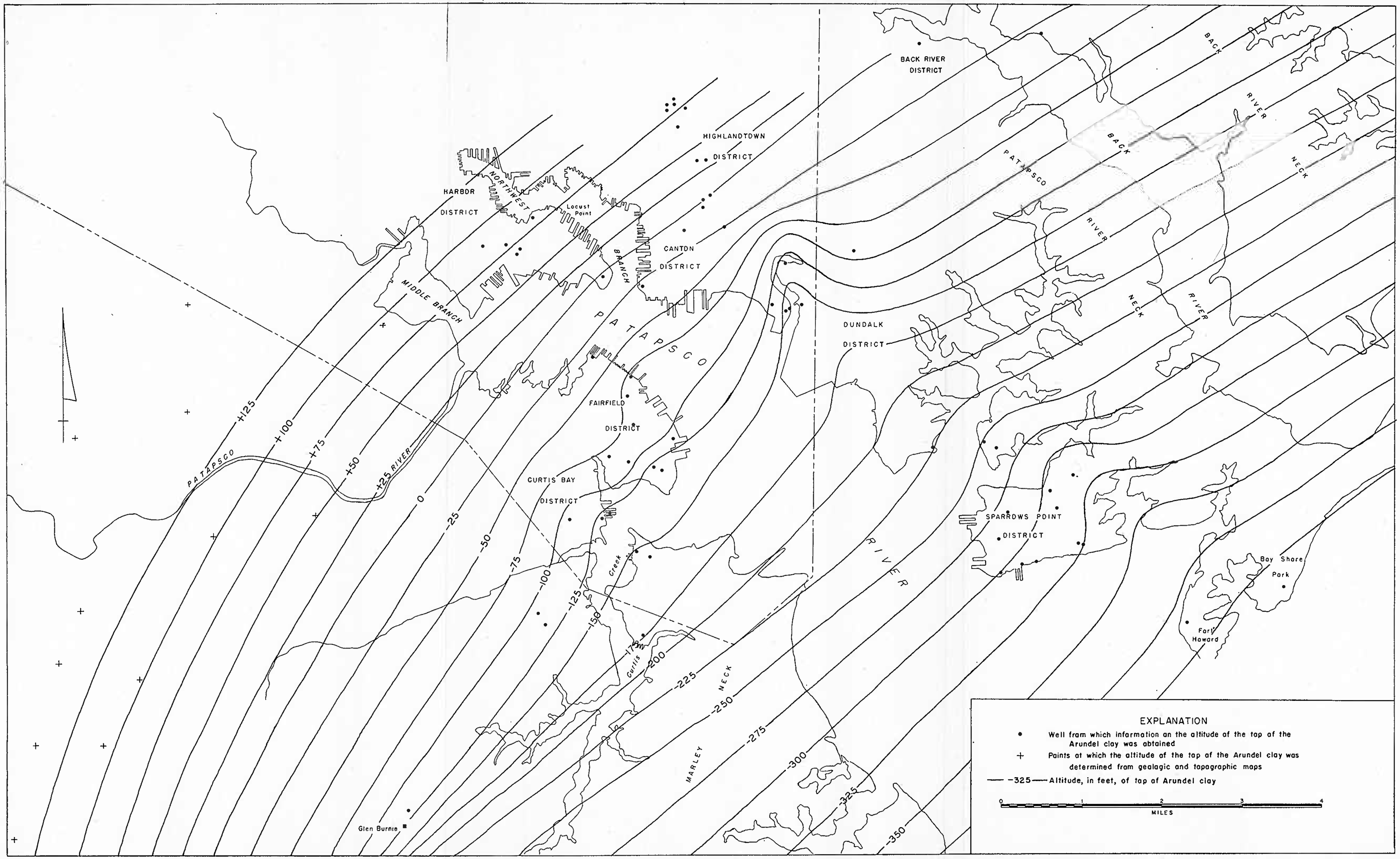
MAP OF BALTIMORE, MARYLAND AND VICINITY, SHOWING THE ALTITUDE OF THE BEDROCK SURFACE BENEATH THE COASTAL PLAIN



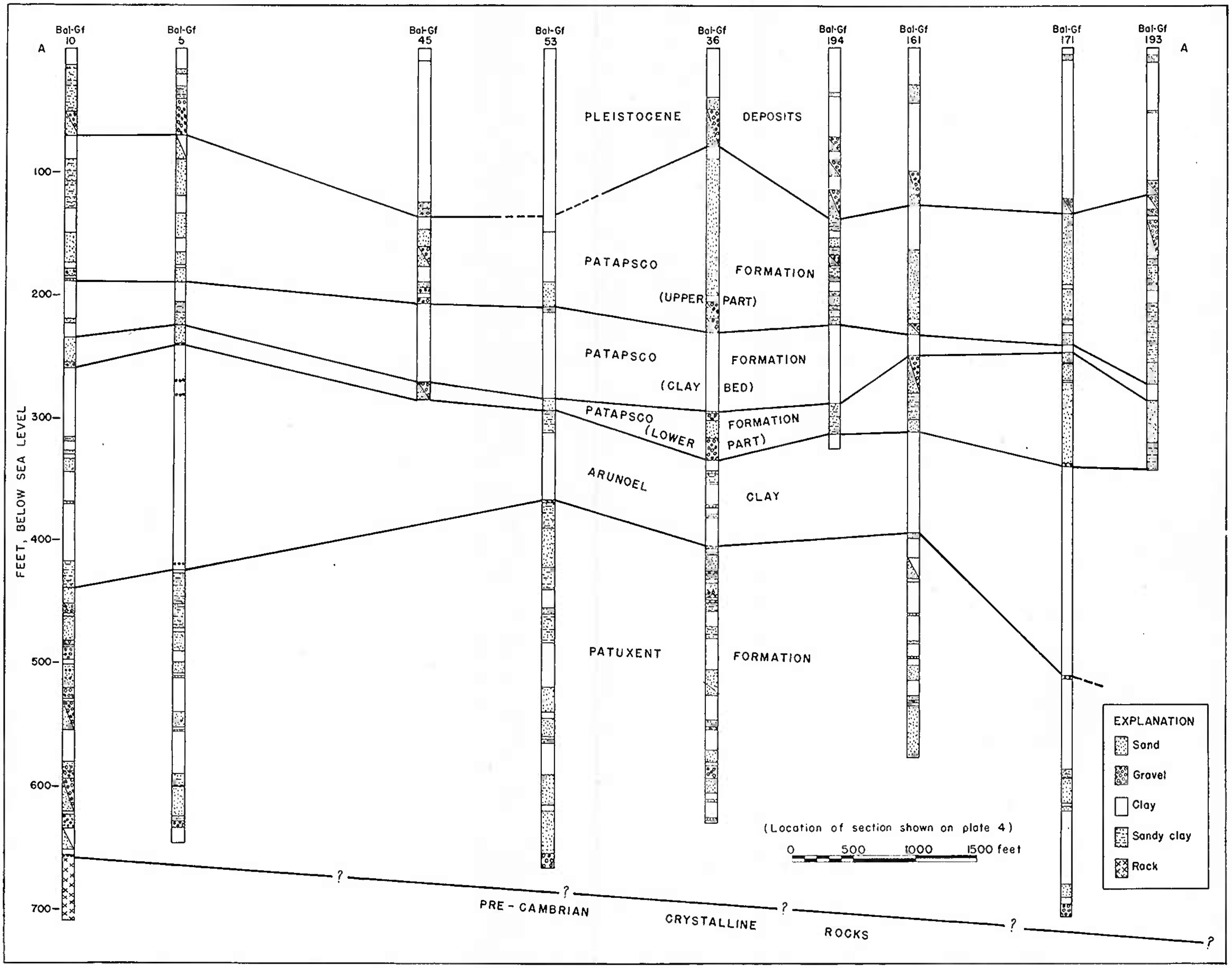
SECTIONAL DIAGRAM SHOWING THE PRINCIPAL WATER-BEARING ZONES AND CONFINING BEDS IN THE BALTIMORE INDUSTRIAL AREA, MARYLAND



MAP OF THE BALTIMORE INDUSTRIAL AREA, MARYLAND, SHOWING THE APPROXIMATE ALTITUDE OF THE ARTESIAN HEAD IN 1945, AND THE GENERAL PATTERN OF THE GROUND-WATER FLOW LINES IN THE PATUXENT FORMATION



MAP OF THE BALTIMORE INDUSTRIAL AREA, MARYLAND, SHOWING THE APPROXIMATE ALTITUDE OF THE TOP OF THE ARUNDEL CLAY



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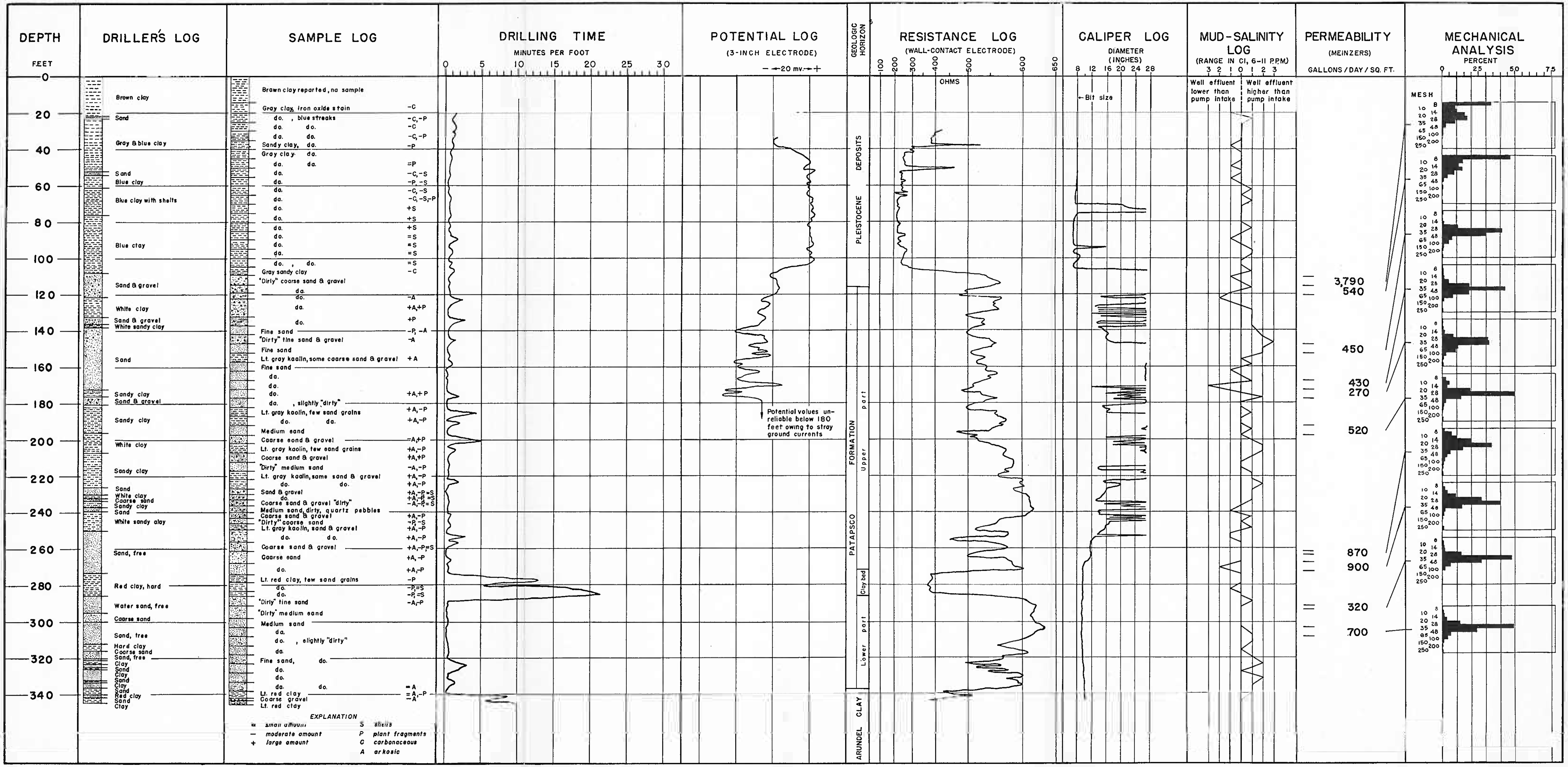

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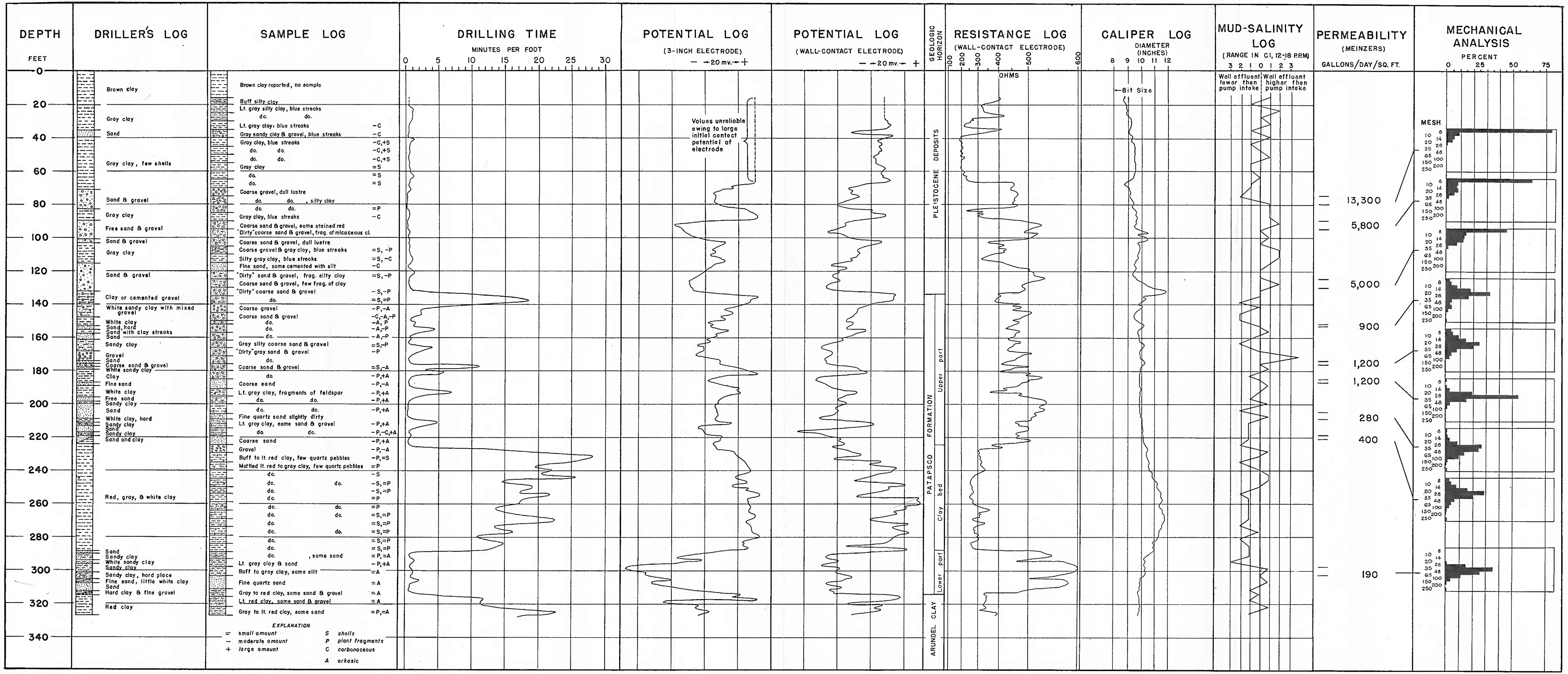

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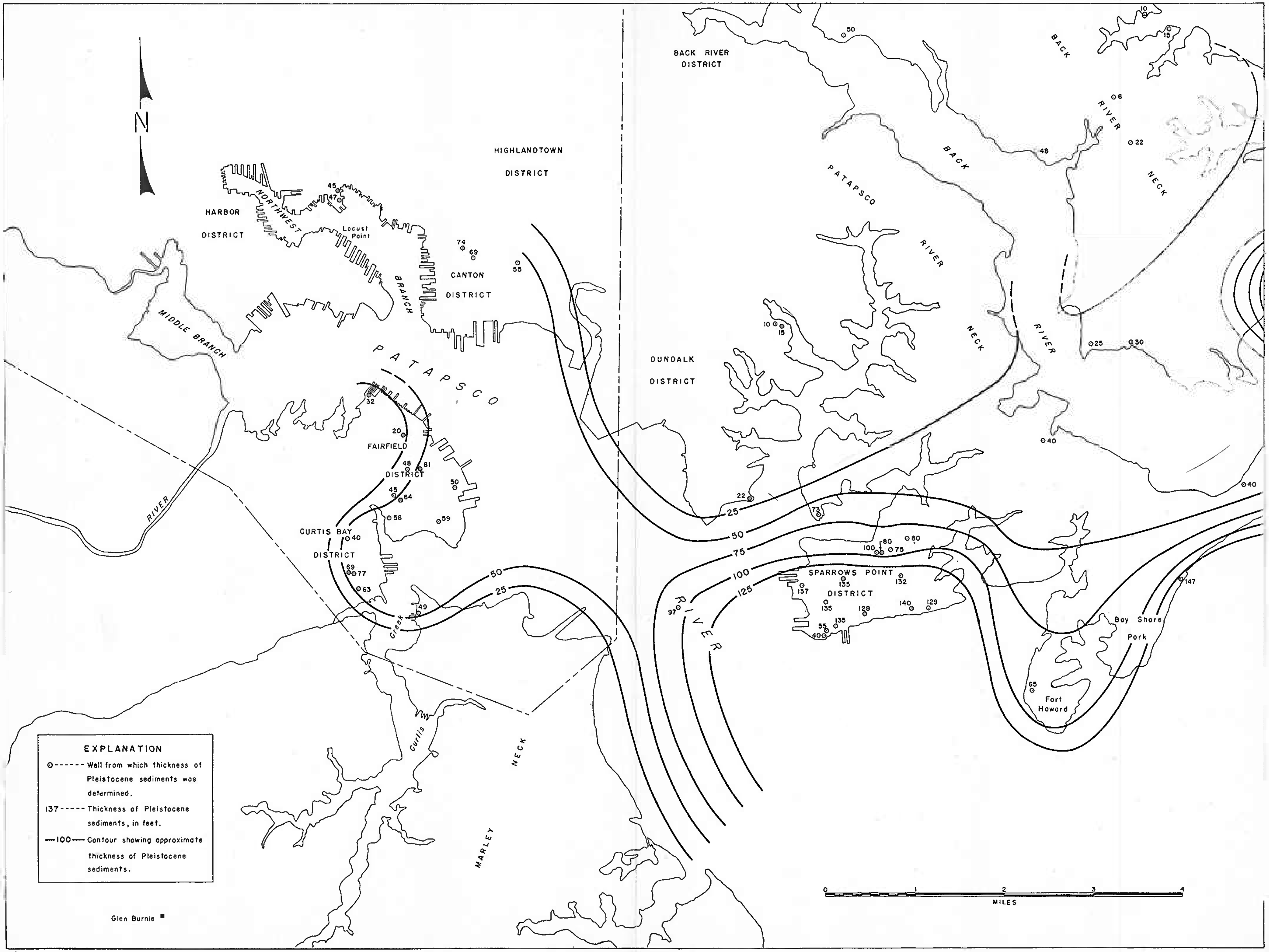

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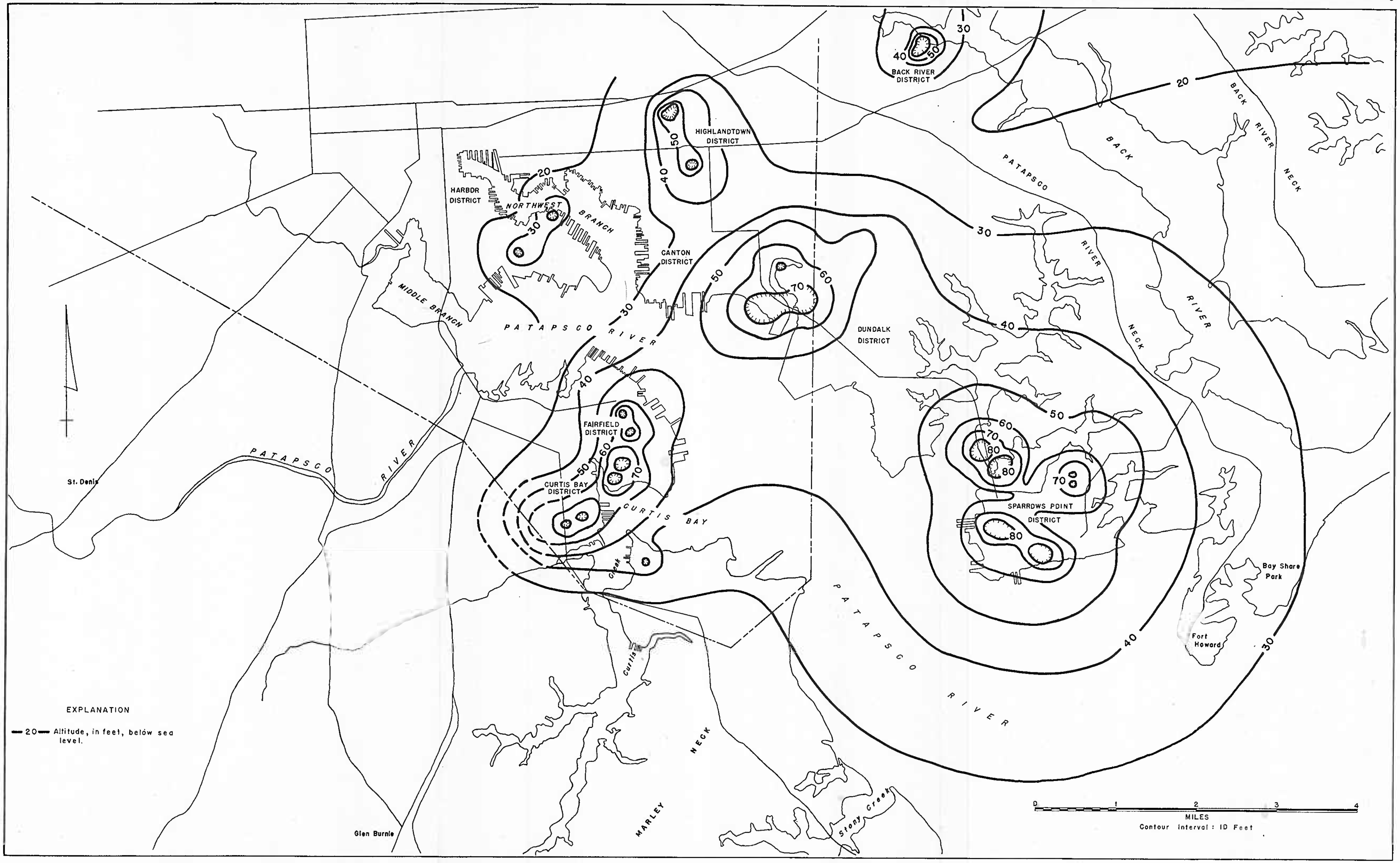
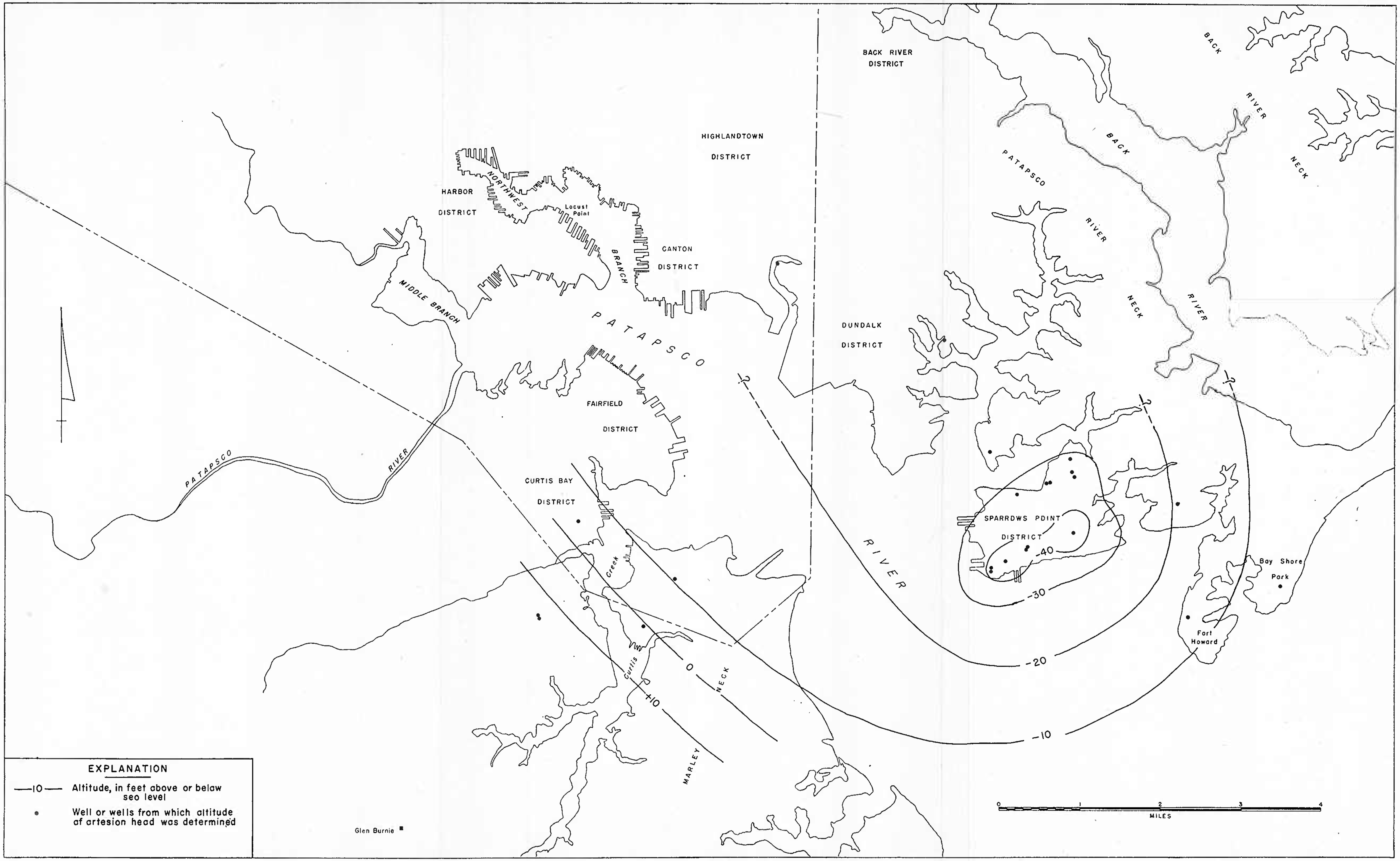


MAP OF THE BALTIMORE INDUSTRIAL AREA, MARYLAND, SHOWING THE APPROXIMATE ALTITUDE OF THE ARTESIAN HEAD, IN 1945, IN THE PATUXENT FORMATION



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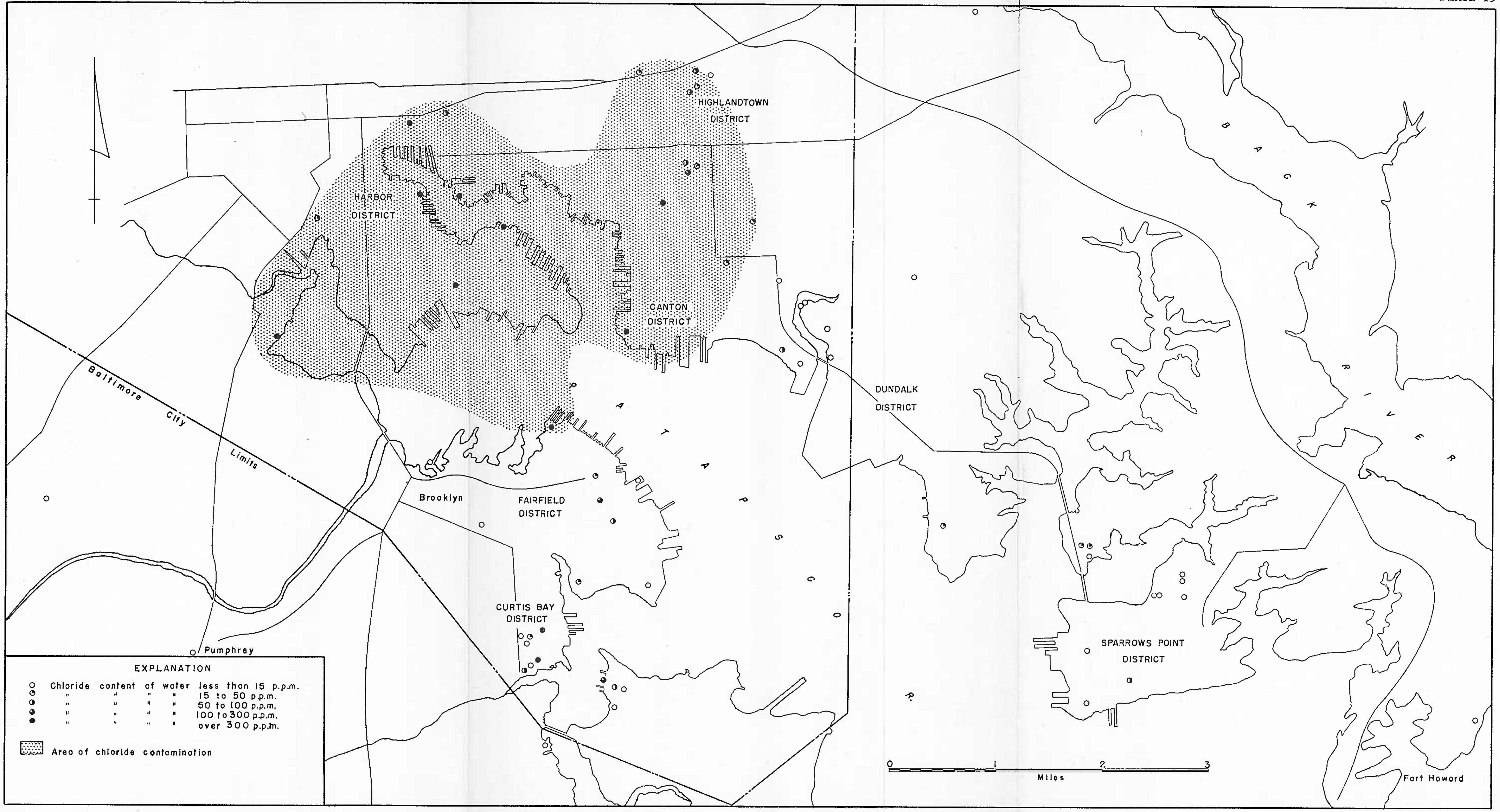

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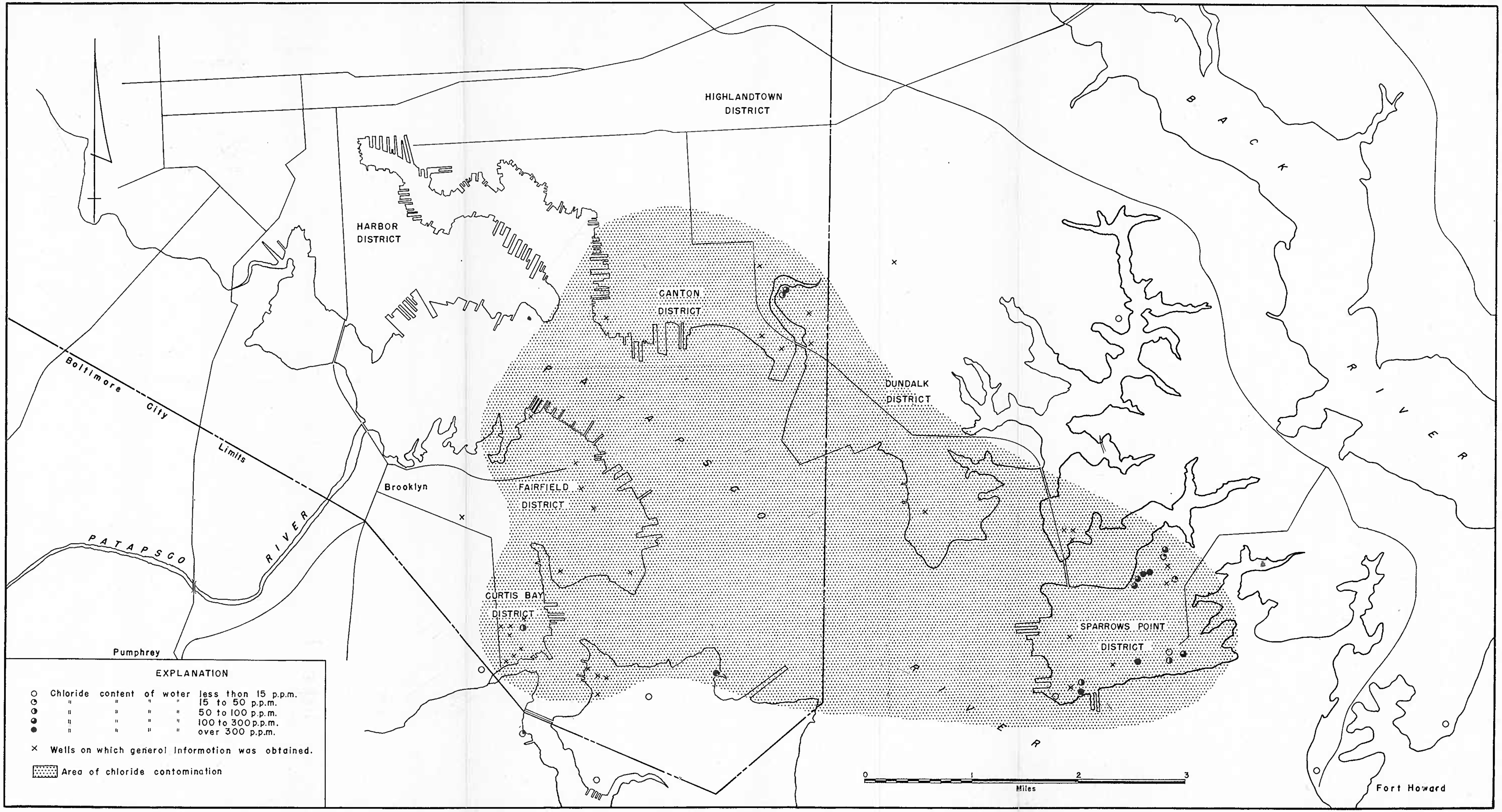
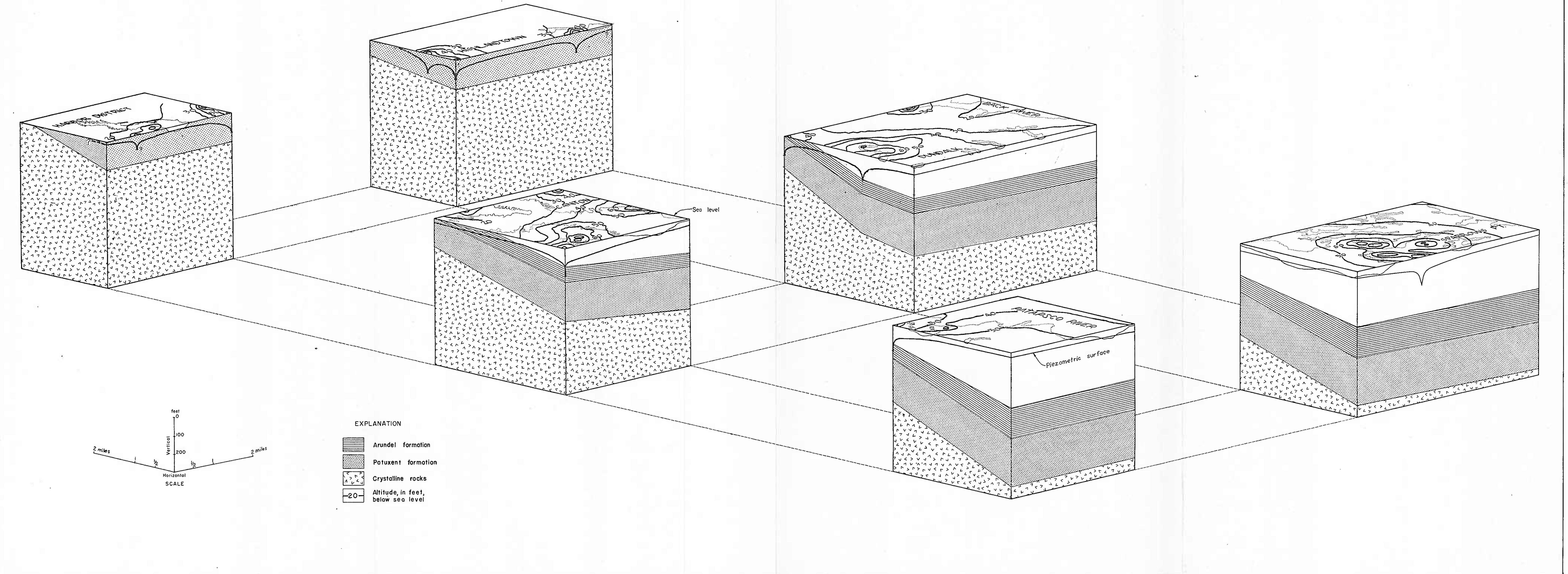


MAP OF THE BALTIMORE INDUSTRIAL AREA, MARYLAND, SHOWING SALT-WATER CONTAMINATION IN THE SANDS ABOVE THE ARUNDEL CLAY IN 1945



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